



# School of Engineering

## 2012-2013 PROGRAM GUIDE

### Bachelor of Engineering (B.Eng.)

University of Guelph

## Follow YOUR Program Guide

The School of Engineering Program Guide is required reading material for students registered in the B.Eng. Program.

All students accepted into the B.Eng. Program for Fall 2012 or Winter 2013 must follow the **Schedule of Studies** for their registered program as outlined in the **2012-2013 Undergraduate Calendar** and **this Program Guide** throughout their entire engineering program. The best way to plan ahead and keep track of your course requirements is to follow your Program Guide. Students are not permitted to mix and match courses with program guides from previous or subsequent calendar years. Students should also verify with other departments and course instructors, as required, to ensure that courses listed herein continue to be offered and are not cancelled or rescheduled.

The University reserves the right to change without notice any information contained in this Program Guide, including regulations for admission, continuation of study, course offerings and provision of facilities. Any curriculum changes or academic announcements that may affect or alter the information found in this Program Guide will normally be sent to you via your uoguelph email account and/or posted on the School of Engineering (SOE) website: <http://www.soe.uoguelph.ca>.

Students should refer to the **current** Undergraduate Calendar for important deadlines, rules and regulations, procedures for academic consideration and appeals, and continuation of study requirements: <http://www.uoguelph.ca/registrar/calendars/undergraduate/current/>.

## Student responsibilities

In addition to the student responsibilities published in Section I of the Undergraduate Calendar:

- It is the responsibility of each student to ***use*** their uoguelph email account for all university correspondence. Yahoo, gmail, hotmail, etc. are not acceptable.
- It is the responsibility of each student to ***maintain*** their uoguelph email account and to ***read*** all official university correspondence.
- It is the responsibility of each student to ***read*** and ***understand*** all academic rules, regulations, procedures and important deadlines as printed in the current Undergraduate Calendar. If a student is still unsure of their responsibilities after reading the information provided in the Undergraduate Calendar or require further clarification, they should contact their Program Counsellor.

***Do not rely on rumours to navigate your way through your program!!!***

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## PROFESSIONALISM

### Accreditation and Becoming a Professional Engineer

In Canada, “Engineer” and “Professional Engineer” are titles restricted by law to those people who have demonstrated their competence and have been licensed in a provincial or territorial Association of Professional Engineers (in Quebec, Ordre des ingenieurs du Quebec). To practice engineering in Canada, it is mandatory to have earned the Professional Engineer (P.Eng.) designation by registering with your provincial or territorial association.

The Canadian Engineering Accreditation Board (CEAB) is a standing committee of Engineers Canada that is responsible for accrediting Canadian undergraduate engineering programs that meet or exceed educational standards for professional engineering registration in Canada. As a graduate from a Canadian accredited undergraduate engineering program, you will be eligible to register as a member of the Professional Engineering Association in the province where you live and work. Requirements for post-graduation experience may vary from province to province.

At Guelph, the baccalaureate degree programs Biological Engineering, Engineering Systems and Computing, Environmental Engineering and Water Resources Engineering are accredited by the Canadian Engineering Accreditation Board of Engineers Canada. According to CEAB regulations, the Mechanical Engineering Program will be eligible for accreditation when the first incoming class graduates in June 2013. Computer Engineering and Biomedical Engineering will be eligible for accreditation in June 2014. 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 of all three new programs.

In Ontario, the Professional Engineers Ontario (PEO) requires four years of acceptable engineering experience upon graduation and successful completion of the Professional Practice Exam on engineering law and ethics. You may apply for your Professional Engineer (P.Eng.) license immediately after graduation or any time thereafter. Most students arrange to write the Professional Practice Exam soon after graduation while the material is still fresh in their minds.

Applicants can also earn up to 12 months work experience during the completion of their engineering degree through co-operative education or summer employment. The quality of the pre-graduation work experience will be measured against five quality-based criteria. Only pre-graduation work experience acquired after the mid-point of your undergraduate program is eligible for credit. It is strongly recommended that letters of reference be obtained from a professional engineer who is familiar with your work experience before you return to school after a coop work term or summer employment. These letters may be difficult to obtain if you wait until after graduation. Be sure the letter contains the reference's contact information for follow-up by the PEO.

To facilitate a better understanding of the PEO, a Student Membership Program (SMP) for undergraduate students has been initiated by the School of Engineering at the University of Guelph. The School of Engineering encourages all students become SMP members. This membership is provided free of charge by PEO. For more information about becoming a PEO student member, please contact the Engineering Society (EngSoc) at extension 58549, Dr. Richard G. Zytner, P.Eng., FEC (rytner@uoguelph.ca), or log onto: [www.engineeringstudents.peo.on.ca](http://www.engineeringstudents.peo.on.ca).

Students are encouraged to contact the PEO regarding information about P.Eng. licensing procedures, writing the Professional Practice Exam, or pre-graduation work experience.

#### **Professional Engineers Ontario**

1000-25 Sheppard Ave. W.

Toronto, Ontario

M2N 6S9

[www.peo.on.ca](http://www.peo.on.ca)

Phone: (416) 224-1100

Toll free: 1 (800) 339-3716

Fax: (416) 224-8168

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### School of Engineering Code of Ethics

The School of Engineering has adopted the Engineering Code of Ethics. Please refer to the School of Engineering Website for more information <http://www.uoguelph.ca/engineering/undergrad-counselling-ethics>.

Failure to follow the Code of Ethics will initiate a review of the offence according to the University of Guelph's Academic Misconduct Policy as described in the current Undergraduate Calendar. This includes any other academic misconduct offence as outlined under Academic Misconduct in the Undergraduate Calendar.

### Blue Pages

Once the academic misconduct process has run its course and an occurrence of academic misconduct has been confirmed, the details (without naming the student or the course involved) will be published in the School of Engineering's Blue Pages as is done in the PEO Dimensions regular publication. Please refer to the School of Engineering website for more information (<http://www.uoguelph.ca/engineering/blue-pages>)

### Academic Integrity & Misconduct

The University of Guelph provides guidance to students regarding academic integrity at the following website: <http://www.academicintegrity.uoguelph.ca/index.cfm>

As per the definition published in Section VIII, Undergraduate Degree Regulations and Procedures of the Undergraduate Calendar, "**Academic misconduct** is behaviour that erodes the basis of mutual trust on which scholarly exchanges commonly rest, undermines the University's exercise of its responsibility to evaluate students' academic achievements, or restricts the University's ability to accomplish its learning objectives.

The University takes a serious view of academic misconduct and will severely penalize students, faculty and staff who are found guilty of offences associated with misappropriation of others' work, misrepresentation of personal performance and fraud, improper access to scholarly resources, and obstructing others in pursuit of their academic endeavours. In addition to this policy, the University has adopted a number of policies that govern such offences, including the policies on Misconduct in Research and Scholarship and the Student Rights and Responsibilities regulations. These policies will be strictly enforced.

It is the responsibility of the University, its faculty, students and staff to be aware of what constitutes academic misconduct and to do as much as possible through establishment and use of policies and preventive procedures to limit the likelihood of offences occurring. Furthermore, individual members of the University community have the specific responsibility of initiating appropriate action in all instances where academic misconduct is believed to have taken place. This responsibility includes reporting such offences when they occur and making one's disapproval of such behaviour obvious.

University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students should also be aware that if they find their academic performance affected by medical, psychological or compassionate circumstances, they should inform the appropriate individuals (instructors, program counsellors, graduate advisors) and follow the available procedures for academic consideration outlined in the University's calendars."

### *Offences & Penalties*

Please refer to the current Undergraduate Calendar, Section VIII, Undergraduate Degree Regulations and Procedures – Academic Misconduct for definitions of academic misconduct offences and the list of penalties.

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## PROGRAM INFORMATION

### Admission Requirements

The following Ontario Grade 12 secondary school credits are required for application to the B.Eng. program.

English (ENG4U)

Advanced Functions (MHF4U)

Calculus (MCV4U)

2 credits from: Biology (SBI4U), Chemistry (SCH4U) or Physics (SPH4U)

1 additional 4U or 4M credit

Specific secondary school admission requirements for applicants from other provinces, transfer students and international students can be found in Section IV Admission Information in the Undergraduate Calendar or on the Admission Services Website:

<https://admission.uoguelph.ca/Home.aspx?SiteID=ded7a702-26e3-4bd1-a69d-da4ea7ee21f3>

Grade 12 Physics and Chemistry are strongly recommended. Applicants who lack one of these credits will be required to take a replacement credit in Semester 1. The credit placed on the university transcript for these Grade 12 equivalent courses will not count toward the B.Eng. degree requirements. Please speak with the Engineering Program Counsellor as soon as possible if you are missing any of the entrance requirements.

### Transfer Students

Many students transfer into the B.Eng. Program from other universities and colleges. Most transfer students enter the program with advanced standing (credit transfers or exemptions). The time required to complete your Engineering degree will depend on your outstanding course requirements, course availability (i.e. fall, winter, spring course offerings) and potential course timetable conflicts.

You should consult the Engineering Program Counsellor for an explanation of your credit transfers and conditions of admission and for help in selecting courses. Requests for credit transfers in addition to those included in your offer of admission must be made by the end of your first semester in the B.Eng. Program. The form to request additional credit transfers is available on the SOE website: <http://www.uoguelph.ca/engineering/undergrad-counselling-forms>.

### International Exchange Programs

Engineering students are encouraged to investigate the many opportunities offered by the Centre for International Programs (CIP). Studying in another country provides a cultural experience that can be highly beneficial not only for personal development, but also for professional development. The University of Guelph has international exchange agreements with over 65 institutions around the world, with more than 25 offering engineering programs. Many of Guelph's non-English university partners teach courses in English. This includes the National University of Singapore (NUS), one of the top ten universities in the world, which offers an engineering program recognized worldwide for its innovation and international perspective. In recent years, engineering students from Guelph have attended the University of Lund in Sweden and the University of Adelaide in Australia.

Engineering students can also take advantage of University of Guelph's Semester Abroad Programs in Krakow, India and London, Paris, and Guatemala. Semester Abroad programs involve up to 25 Guelph students traveling overseas with a Guelph professor for a semester, with courses taught in English by on-site faculty. For more information on exchange and Semester Abroad programs please visit: <http://www.uoguelph.ca/cip/> or drop by CIP on the 3<sup>rd</sup> floor of the University Centre.

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Students interested in participating in an international program should be aware that not all courses required for their engineering degree program can be taken abroad. The decision to study abroad often results in additional time required to complete your degree. However, many believe the experience far outweighs the time commitment. If you plan early enough, it may be possible to still finish your degree in eight semesters. Applications for exchange are completed entirely online. To gain access to the online application, you must first sign up for and attend an information session at the CIP.

Students are encouraged to consult with the CIP to investigate exchange program opportunities and to discuss their course sequencing with their program counsellor. Tentative course approval prior to departing on an exchange is required.

In addition to undergraduate study programs, some countries offer summer research opportunities. A good example would be a research semester offered by the German Academic Exchange Service. More information can be found at: <http://www.daad.org/>.

### Co-operative Education Program

The co-operative education program offers an excellent opportunity to develop your technical and personal skills in the professional world. Participants in the co-op program must complete a minimum of four work semesters (out of the five available) alternated with eight academic semesters as indicated in the schedule below. Of the four required work semesters, one must be completed in the fall and one must be completed in the winter.

Year	September-December	January-April	May-August
1	Semester 1	Semester 2	Off
2	Semester 3	Semester 4	Work Semester
3	Semester 5	Work Semester	Work Semester
4	Semester 6	Semester 7	Work Semester
5	Work Semester	Semester 8	Graduate!

Students can enter the co-op program directly from secondary school or can be admitted, depending on space availability, after completion of Semester 2. Requirements for eligibility include full time registration in Semesters 1 and 2, and a minimum cumulative average of 70% at the completion of Semester 2. Applications should be submitted directly to the Co-operative Education Office, Trent Lane, Building #54.

Please consult the Co-operative Education website <http://www.cecs.uoguelph.ca/home/> for more information about co-op programs.

Advisor for Water Resource Engineering and Environmental Engineering:  
Andrea Bradford (Co-Chair), Email: [abradfor@uoguelph.ca](mailto:abradfor@uoguelph.ca)

Advisor for Mechanical Engineering:  
Fantahun Defersha, Email: [fdefersh@uoguelph.ca](mailto:fdefersh@uoguelph.ca)

Advisor for Computer Engineering and Engineering Systems & Computing:  
Stefano Gregori, Email: [sgregori@uoguelph.ca](mailto:sgregori@uoguelph.ca)  
Simon Yang (Co-Chair), Email: [syang@uoguelph.ca](mailto:syang@uoguelph.ca)

Advisor for Biological Engineering and Biomedical Engineering:  
Suresh Neethirajan, Email: [sneethir@uoguelph.ca](mailto:sneethir@uoguelph.ca)

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### Undergraduate Engineering Scholarships & Awards

Scholarships and awards are available to students with high academic achievement, involved in extra-curricular activities, or who are in financial need. A description of all available awards and eligibility requirements is provided in Section IX, Scholarships and Other Awards in the current Undergraduate Calendar and is updated every year. Several scholarships and awards are available only to engineering students. Please see the listing in the current Undergraduate Calendar for more information.

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c09/c09beng.shtml>

Dr. Ramesh Rudra, P.Eng. is the Chair of the School of Engineering Awards Committee. Please contact him at [rrudra@uoguelph.ca](mailto:rrudra@uoguelph.ca) if you have any questions or wish to apply for any of the Engineering awards.

### Addition of a Minor

Students majoring in the B.Eng. Program can add a Minor from almost any degree program offered by the University of Guelph. A Minor can be added at any time, however, if you plan to add one of the two Engineering Minors, you must do so before enrolling in ENGG\*3100 in Semester 6 [Regular] or Semester 7 [Coop]. If you elect to add a Minor from outside of the Bachelor of Engineering degree program, you must contact the faculty advisor for the specialization that you chose (ie. Business Administration from Bachelor of Arts). A list of faculty advisors can be found on the Undergraduate Academic Information Centre website: <http://www.uoguelph.ca/uaic/facultyadvisors>

The Minor you add must be available in the same undergraduate calendar year listed on your Program Evaluation for your Bachelor of Engineering degree program. For example, if you began your Engineering degree in Fall 2012 and you add a minor in 2014, the program of study for the minor must follow the 2012/13 Undergraduate Calendar.

Please see Section X--Degree Programs in the appropriate Undergraduate Calendar for more details about available Minors by degree program:

[http://www.uoguelph.ca/undergrad\\_calendar/c10/index.shtml](http://www.uoguelph.ca/undergrad_calendar/c10/index.shtml)

#### *How to Add a Minor*

You can obtain an "Undergraduate Schedule of Studies Change Request" form from Undergraduate Services on the 3rd floor of the University Centre. Both the B.Eng. Program Counsellor and the Faculty Advisor for the Minor you wish to add must sign the form prior to you submitting the form to Undergraduate Services.

### Continuation of Study

All students must follow the Continuation of Study model outlined in Section VIII -Undergraduate Degree Regulations and Procedures in the Undergraduate Calendar.

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-contstudy.shtml>

To continue studying at the University of Guelph, you must satisfy the conditions set out in Schedule 1 or Schedule 2. Most students who are admitted directly from secondary school follow Schedule 1, whereas students who transfer or are re-admitted generally follow Schedule 2. Please refer to the Undergraduate Calendar for further explanation or consult the Engineering Program Counsellor if you are unsure of which Schedule you are to follow.

Additionally, students are advised that there is a program restriction that takes effect when registering for the course, ENGG\*3100, in the winter semester of year three. Specifically, students must have a minimum cumulative average of 60% in all ENGG courses to register for ENGG\*3100.



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## 3rd-Failure Rule

Students will be removed from the B.Eng. Program and will not be eligible for readmission to Engineering if the **same** course is failed three times (this includes elective courses). If you have failed a course three times and your continuation of study status is either eligible to continue or probationary, your university degree status will be changed to non-degree. If you are eligible to continue at the university, you may apply for admission to another degree offered by the University through the Admissions Department provided you meet the minimum admissions requirements. Students are advised to meet with the Program Counsellor for the degree program for which they wish to apply before making an application.

## Graduation

**To qualify for your B.Eng. degree you must complete all of the required courses and elective courses as listed in the Schedule of Studies of the 2012-2013 Undergraduate Calendar and this Program Guide.**

To graduate, 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. You must also achieve a minimum overall cumulative average of 60% and a minimum cumulative average of 60% in all ENGG courses. Please see Section X, Degree Programs, Bachelor of Engineering [B.Eng.] in the 2011/12 Undergraduate Calendar for full program requirements.

Refer to Section VIII - Undergraduate Degree Regulations and Procedures in the University of Guelph Undergraduate Calendar for an explanation of the general requirements for graduation.  
<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-gradn.shtml>

**It is each student's responsibility to know if their graduation requirements have been met.** The best way to track your degree requirements is to consult your personal **Academic Evaluation** page on your Webadvisor account. The academic evaluation is an accounting sheet of the courses and credits that must be completed to qualify for your undergraduate degree major in addition to other programs in which you might be enrolled such as co-operative education, minors or certificates. The Academic Evaluation page also contains the following important information:

- Student name, mailing address and ID number
- Program (*major and, if applicable, co-op, minors, certificates*)
- Class Level (*needed to identify your course selection window*)
- Standing (*academic status at the end of previous semester; e.g., Dean's Honour List, Eligible to Continue, Probation, Required to Withdraw*)
- Catalogue (*indicates the undergraduate calendar year you are following for your Schedule of Studies*)
- Official uoguelph email address

## Academic Standing

### *Eligible to Continue (ETC)*

A student who satisfies the program requirements for continuation of study will be eligible to continue (ETC). Students who are ETC may register for courses on-line (via Webadvisor), provided they meet the prerequisite requirements.

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### *Probation (PRB)*

A student who is placed on probationary status will be permitted to continue in their program, but has been identified as being at academic risk. Students who are placed on probation are strongly advised to meet with their Program Counsellor to understand their academic options and request information about appropriate on-campus services that the student can access for help to get back on track (see Continuation of Study in this section for a link to Undergraduate Calendar regarding probation status).

### *Required to Withdraw (RTW)*

A student who does not satisfy the program requirements for continuation of study will be required to withdraw from the University for a minimum of two semesters (see Continuation of Study in this section). Students who do not satisfy the program requirements may appeal to the Academic Review Committee for probationary status to be granted if they have medical, psychological or compassionate grounds as outlined in the Undergraduate Calendar. A student who has been required to withdraw and who has made an appeal for probationary status to the Academic Review Committee will not be allowed to attend classes until such time that the appeal is granted.

Readmission to a program at the University of Guelph after being required to withdraw is not automatic. Students who are required to withdraw are not permitted to register in courses during the two-semester rustication period and they must apply for readmission. Conditions for applying for readmission to the University of Guelph after being required to withdraw are provided at the following Undergraduate Calendar link:

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-readmit.shtml>

Students who have been required to withdraw, and wish to be readmitted to the B.Eng. Program must also meet the conditions for substantial upgrading. Please contact your Engineering Program Counsellor for more information about engineering upgrading requirements.

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## COURSE INFORMATION

### Course Selection

The course selection period for the following semester occurs near the mid-term point of the current semester. Students can pre-select their courses when their selection window opens. Selection windows are based on your student ID number and your class level, both of which can be found on your Academic Evaluation page on your Webadvisor account. The course schedule is available for viewing on Webadvisor approximately 2 weeks prior to the start of the course selection period. Students are advised to identify ahead of time sections that would work best for their Schedule of Studies and to identify back-up options in case their first choice fills before their window opens.

The final exam schedule is not available during the course selection period, but is posted prior to the beginning of the final add period for the following semester. It is the student's responsibility to check the final exam schedule before the next semester begins, and when adding courses to their schedule during the Final Add Period.

The final add period is open to all students with active status and there are no selection windows.

The start and end dates of all course selection periods and add periods are published in Section III, Schedule of Dates in the Undergraduate Calendar.

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c03/index.shtml>

After the semester begins, requests to add a course after the last day of the add period, as published in the Schedule of Dates in the Undergraduate Calendar, will be denied unless the student can provide a reasonable explanation for extenuating circumstances. There is plenty of opportunity to add courses long before the semester begins. Line ups and/or neglect are not acceptable excuses.

### Course Prerequisites

The majority of courses offered by the School of Engineering have course prerequisites. As such, you need to obtain credit in the prerequisite course or courses before you are allowed to enrol in the subsequent course.

A student wishing to register in a course for which he/she does not have credit for the prerequisite(s) may request permission from the course instructor to have the prerequisite(s) waived. The student seeking the waiver must obtain a "Course Requisite/Restriction Waiver" form, request it to be signed by the instructor and submit the completed form to Undergraduate Services for processing. Waiver forms are available from Undergraduate Services, Office of Registrarial Services, 3<sup>rd</sup> Floor North of the University Centre.

The pink copy of the waiver form for all ENGG courses and MATH\*2270 must be submitted to the Engineering Program Counsellor, or else you risk being department dropped from the course and the section that best works in your schedule.

The decision to sign a waiver rests with the individual course instructor. However, the School of Engineering faculty have voted in favour of a department policy to strictly enforce prerequisites for all ENGG courses. One exception to this recommendation is for transfer students where extenuating circumstances exist. This does not mean that transfer students are guaranteed that waiver forms will be signed. The course instructor still makes the decision on an individual basis.

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### Dropping Courses

Courses must be dropped by the end of the fortieth (40th) class day. Students wishing to drop a course after the fortieth (40th) class day must appeal to the Academic Review Committee and they must have grounds for academic consideration as outlined in the Undergraduate Calendar. Please note there is NO guarantee that your request will be granted. Please refer to Section VIII, Undergraduate Degree Regulations and Procedures in the Undergraduate Calendar for a description of grounds for Academic Consideration. Forms for Academic Consideration may be picked up at Undergraduate Services on the 3<sup>rd</sup> Floor of the University Centre or the Engineering Counselling office THRN 1401.

It is important to remember that if you drop a course, you may not have the prerequisite for a subsequent course.

### Letters of Permission

From time to time, students who are off-stream from their Schedule of Studies may wish to take a course at another institution as a visiting student to get caught up in their program and/or back on sequence with their Program Guide. It is important to note that transfer credit for individual courses will not be granted without first obtaining a Letter of Permission. Students who register in a degree program at another institution will be required to apply for readmission to Guelph should they wish to return. Readmission is not guaranteed and students would need to meet the minimum admission requirements.

**IMPORTANT:** Only students with “eligible to continue” status under the Continuation of Study requirements will be permitted to take courses on letter of permission.

Information regarding the procedure for requesting a Letter of Permission is provided in Section VIII of the Undergraduate Calendar:

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-lop.shtml>

### Supplemental Privilege

Supplemental privileges are granted at the discretion of the Academic Review Committee, affording a student who has received a failing grade on the original course attempt the opportunity to obtain credit for the course while retaining the original failing grade.

Students registered in the B.Eng. program are normally permitted only one supplemental privilege during their studies. A supplemental privilege may be granted for 3000 or 4000 level courses by the Academic Review Committee provided the course failure impacts the time line for graduation.

**NOTE:** A supplemental privilege is considered a separate course attempt and is intended to provide an evaluation of the full course material. If a student does not pass the supplemental privilege an additional failure in the course will be added to their transcript. Students who request a supplemental privilege are reminded that the B.Eng. degree has a 3<sup>rd</sup> failure rule which includes attempts for supplemental privilege.

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## COUNSELLING & HELP

### Engineering Program Counsellor

Academic counselling is available to you throughout your academic career at the University of Guelph. You are encouraged to take the initiative and seek advice from the Engineering Program Counsellor and/or Faculty within the School of Engineering when necessary. Typical situations include, but are not limited to, the following:

- experience personal difficulties that are affecting your courses
- have low marks even though you have been working hard
- feel that proper procedures aren't being followed in one of your classes
- wish to appeal a grade or decision
- wish to withdraw from the current semester
- are having course selection problems
- wish to transfer programs or take courses at another institution
- have been ill and missed assignments, labs or exams

Appointments are required to meet with a program counsellor. During course selection and final add periods, drop-in hours will be posted.

Please note that The University's Policy on Release of Student Information stipulates that personal information of students, including academic-related information, cannot be disclosed to an individual other than the student without written permission from the student. Should your parents or anyone other than yourself wish to grant access to information held by the School of Engineering, permission must be given in writing and faxed to 519-836-0227. The letter of permission will need to include the following:

- Student Name
- Student ID
- Name(s) of individual(s) to whom information may be released
- Date
- Student signature

It is encouraged to make an appointment yourself to discuss the issue in person.

All email communication should be used with your uoguelph.ca account. This email should be made a primary email as you will receive important updates throughout your academic school years.

#### **B.Eng. Program Counsellor:**

Kim Thompson, P.Eng.

Room 1414, Thornbrough (Engineering) Building  
Phone: (519) 824-4120 ext 56986; Fax: (519) 836-0227  
Email: engcouns@uoguelph.ca

#### **B.Eng. Undergraduate Secretary:**

Paula Newton

Room 1401, Thornbrough (Engineering) Building  
Phone: (519) 824-4120 ext. 56572; Fax: (519) 836-0227  
Email: engcouns@uoguelph.ca

## Engineering Program Guide (Fall 2012- Winter 2013)

**To book an appointment with the Engineering Program Counsellor** submit the on-line request form located on the SOE Academic Website:

<http://www.soe.uoguelph.ca/academic/pages/home.html#>

If you prefer to ask your question by email without booking an appointment, you are also requested to use the on-line form.

**The B.Eng. Program Counsellor email account, [engcouns@uoguelph.ca](mailto:engcouns@uoguelph.ca), receives a large volume of emails daily. Using the on-line form will give priority to your question or appointment request. Emails not received via the on-line request form may not receive a reply for several days and at times up to a week, depending on volume.**

### Engineering Peer Helper Program

[http://www.uoguelph.ca/engineering/peer\\_helper](http://www.uoguelph.ca/engineering/peer_helper)

The Engineering Peer Helper Program is a partnership between the School of Engineering (SOE) and Learning Services of the Learning Commons to support engineering students. The program officially started in Winter 2009. Academically successful and experienced engineering students are selected through an interview process by the SOE and trained by Learning Services to provide assistance with problem-solving techniques and other learning strategies necessary for success in engineering courses.

Engineering Peer Helpers provide valuable assistance to students registered in the B.Eng. program through structured study sessions and individual assistance on learning-related issues. The Engineering Peer Helper program is specifically designed to target the **development of skills and methodologies** for problem solving, time management and exam preparation as it relates to the engineering curriculum.

Although specific engineering courses are associated with the Engineering Peer Helper program for the purpose of demonstration and implementation of various learning strategies, registration in these courses is not mandatory to be eligible to attend the sessions. All students registered in the B.Eng. program are encouraged to attend. The Engineering Peers are like coaches who are equipped to help you develop essential skills in a relaxed and friendly environment. They do not teach course content or fundamental concepts. You must go to class for that or meet with your course instructor during posted office hours.

Recruitment for new Engineering Peers takes place in February of each year.

More information about the dates and times of the Engineering Peer Helper study sessions will be announced on the SOE website and will be emailed to students registered in the B.Eng. program at various times throughout the year.

### Other On-Campus Help Services

#### *Counselling Services*

The University provides a broad range of on campus programs, services and resources to assist students with academic and personal issues. We want to provide you with all the necessary resources to ensure your success at Guelph!

Counsellors and therapists from a variety of backgrounds provide support to students who are experiencing problems of a personal nature. Counselling offers you the opportunity to talk to a counsellor to explore, understand and work through personal issues and meet your goals. Students may seek personal or group counselling to deal with issues such as adjusting to university life, interpersonal difficulties, relationships, stress management, depression, eating concerns or bereavement. Counselling Services is located on Level 3 in the University Centre or at ext. 53244.

<http://www.counselling.uoguelph.ca/counselling/>

# Engineering Program Guide (Fall 2012- Winter 2013)

## *Learning Services*

The goal of Learning Services is to promote excellence in learning and writing across the university curriculum and into the world of work. A broad range of services is provided for undergraduate students including workshops, seminars, non-credit courses, individual consultations, printed resources and on-line services. Services that may be of interest to engineering students include:

- Exam Preparation
- Learning from Lectures
- Learning from Texts
- Learning with Computers
- Memory & Concentration
- Presentation Skills
- Time Management
- Working in Groups

Learning Services is located in the Learning Commons on the first floor of the Library.

## *The Learning Commons*

The Learning Commons is a consortium that links together the Library, Computing and Communications Services, Office of Open Learning, Student Affairs, Teaching Support Services. With student learning at its focus, Guelph's Learning Commons consolidates services related to teaching, learning, writing, research, and information and computer literacy into one area. The Learning Commons is located on the first floor of the McLaughlin Library, in the south-west corner behind the CCS computer pool.

<http://www.learningcommons.uoguelph.ca/index.html>

## *Stress Management and High Performance Clinic*

The clinic teaches self-regulation skills training for performance and health to clients from university, health care, and community settings in group, private, and on-site programs. Programs offered include Relaxation and Stress Management Skills, Preventing Repetitive Strain at Computer Tasks, Better Sleep Program, and examSMART. All classes are taught by Kathy Somers, BSc(HK) who is BCIA certified in Stress Management Education.

<http://www.uoguelph.ca/%7Eksomers/>

## Academic Consideration

The School of Engineering operational procedures for requesting academic consideration are provided in this section and are intended for students in the Bachelor of Engineering (B.Eng.) program. Detailed information about the University of Guelph's regulations and procedures for academic consideration is provided in the undergraduate calendar.

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac-ac.shtml>

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

Academic consideration is granted on the basis of appropriate medical, psychological or compassionate grounds. Appropriate grounds for academic consideration are further explained in the undergraduate calendar (see links above). Compassionate refers to circumstances that are beyond the student's control and are unforeseeable.

Academic consideration is not automatic or guaranteed.

## Engineering Program Guide (Fall 2012- Winter 2013)

Students seeking academic consideration are not required to fill out the Request for Academic Consideration form but are encouraged to do so when submitting a request to the Academic Review Committee. The request form provides helpful guidance to the student and clarifies for the committee the action being requested. The form is available at the following locations:

- Undergraduate Services, 3<sup>rd</sup> Floor, University Centre
- School of Engineering Program Counselling Office THRN 1401
- SOE Academic Webpage under "Forms and Program Guides"  
<http://www.soe.uoguelph.ca/academic/pages/home.html>
- Office of Registrarial Services website:  
<http://www.uoguelph.ca/registrar/index.cfm?downloads>

The types of requests for academic consideration are many and varied. *If you believe your situation warrants academic consideration but you are unsure, please book an appointment to meet with the program counsellor for further guidance and direction.*

### *During the Semester*

Requests for academic consideration during the semester are reviewed and decided by the instructor of the course (i.e., late assignments, missed or late lab, missed midterm, etc.). The instructor may ask for documentation to support the grounds stated. Students are encouraged to meet with their program counsellor if they believe consideration has been unduly denied; if multiple courses are affected, or; if the circumstances are severe and are expected to persist throughout the remainder of the semester.

### *After the Semester Ends*

Requests for academic consideration after the semester is completed and during the final exam period are reviewed and decided ONLY by the academic review committee or designate.

**IMPORTANT:** *Course instructors cannot approve deferred exam requests for missed final examinations. All requests for deferred final exams must be submitted to the program counsellor (medical grounds only) or to the academic review committee (psychological or compassionate grounds).*

### *Submission Deadlines*

Requests to the academic review committee may be submitted at anytime. However, submission deadlines for regular meetings of the academic review committee are published in the undergraduate calendar under Section III, Schedule of Dates.

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c03/index.shtml>

### *Where do I submit my documentation and request form?*

Except for the circumstances listed below, all requests for academic consideration should be submitted to Undergraduate Program Services, 3<sup>rd</sup> Floor, University Centre.

For the following circumstances only, requests should be submitted directly to the Engineering Program Counsellor:

- Missed a final exam and have appropriate medical documentation
- Missed a final exam due to death in immediate family and have documentation
- Missed deferred exam (1<sup>st</sup> instance only) and have appropriate medical documentation
- Missed deferred exam (1<sup>st</sup> instance only) due to death in immediate family and have documentation
- Request a late course drop between 40<sup>th</sup> class day and before commencement of the final exam period (see Dropping Courses section in this program guide for more information)



# Engineering Program Guide (Fall 2012- Winter 2013)

## *Supporting Documentation*

Students applying for academic consideration to the academic review committee must provide documentation to support their grounds. Examples of appropriate supporting documentation that apply to typical situations are listed below. Other types of documentation may be needed for unusual or rare cases.

- Medical note from Student Health Services (on-campus)
- SOE off-campus medical form (provided in this program guide and on the SOE website)  
<http://www.soe.uoguelph.ca/academic/pages/home.html>
- Letter from psychiatrist or family physician
- Letter from Student Counselling Services or Centre for Students with Disabilities
- Police report
- Death certificate or funeral notice

Students are strongly encouraged to write a letter describing their circumstances and provide relevant information regarding how they plan to manage their situation in the future to avoid a reoccurrence. Dates and time lines are important.

## *A Note about Privacy*

Supporting documentation is not intended to provide the committee with private personal details, medical or otherwise. The objective is to provide the committee with sufficient information to make an informed decision that both maintains academic integrity and provides the student with appropriate accommodation, where warranted. In essence, the committee needs to know to what extent the circumstances reasonably prevented the student from meeting their academic obligations. Documentation from medical, counselling and legal professionals may be worded to confirm that the symptoms or the impacts of the circumstances were sufficient to impair the student's ability to complete their academic requirements.

## *Decisions and Appeals*

Decisions by the academic review committee are determined by majority vote and are deliberated based on the balance of probability. This means the committee will consider though discussion the credibility of the documentation provided in conjunction with other options the student may have had available to them for managing their academics (for example: dropping a course sooner to manage course load, meeting with the program counsellor to explore options, seeking personal counselling help, etc.). The committee will also consider whether the action being requested is in the best interest of the student, academically, if granted.

Students are not permitted to be present at the academic review committee meeting, which is why it is important to provide complete and accurate supporting documentation and a personal letter. Requests for academic consideration that have been denied may be appealed by contacting the Judicial Officer:

Commissioner of Oaths  
AKA: **Judicial Officer**  
Provost & VP Academic  
UC:L-4  
519-824-4120 x58633

The appeal process is explained further in the undergraduate calendar under the heading, Petitions.  
<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac-ac.shtml>

# Engineering Program Guide (Fall 2012- Winter 2013)

## Grounds for Academic Consideration

Requests for academic consideration are to be accompanied by supporting documentation to the extent possible. Students unsure of documentation requirements should contact their Program Counsellor. Requests that cannot be substantiated through appropriate documentation may be denied.

### *Psychological Grounds*

For academic consideration based on psychological grounds the student will be asked to provide documentation for the period affected. The necessity for documentation will depend in part upon the length of time affected by the circumstances and the amount of work missed during this time. During the semester, the student should submit this documentation to the Program Counsellor who will then advise the instructor of the need for consideration. After completion of the semester, the student must apply to the Academic Review Sub-committee for consideration. When the psychological difficulty affects final examinations or final assignments, Counselling Services, upon receipt of student authorization, may send supporting documentation to the Program Counsellor. If the difficulty is of a duration that will affect a number of courses or completion of the semester's work, the student should contact the Program Counsellor for advice and to discuss their academic options.

### *Compassionate Grounds*

Unforeseen circumstances beyond the student's control in either their personal or family life may affect academic performance. The procedure to follow to request academic consideration based on compassionate grounds depends upon the severity of the circumstance and the amount of work missed. During the semester, students may wish to contact the instructor for consideration for missed semester work resulting from a compassionate circumstance of limited duration. If the circumstance is more significant and is anticipated to affect the remainder of the semester; or if the semester is already completed, the student should consult with the Program Counsellor for advice in making an application to the Academic Review Sub-committee. Generally, work commitments will not constitute grounds for academic consideration.

### *Medical Grounds*

For academic consideration based on medical grounds a student may be asked to provide medical documentation for the period of the illness or injury. The necessity for documentation will depend in part upon the length of the illness and the amount of work missed during this time. If the medical situation results in missed semester work during the semester, the student should contact the instructor, presenting medical documentation where warranted. If the absence due to illness is of a duration that will affect a number of courses or completion of the semester's work, the student should contact the Program Counsellor for advice and to discuss their academic options. When the absence affects final examinations or final assignments the student should go to Student Health Services or a personal physician for documentation. The student must always present medical documentation to the Program Counsellor for missed final exams.

### *Off-campus Medical Documentation*

If you seek medical attention off-campus, the physician must complete a School of Engineering Off Campus Medical Form which can be obtained from the SOE Website (link provided below), or print the form provided in this program guide.

[http://www.soe.uoguelph.ca/academic/pages/forms/off\\_campus\\_medical\\_note\\_050902.pdf](http://www.soe.uoguelph.ca/academic/pages/forms/off_campus_medical_note_050902.pdf)

### *Exclusions*

Missing assignment due dates, midterms and/or final exams due to sleeping in, faulty alarm clocks, entertainment events, flight or travel plans, vacation and/or misreading course outlines, final exam schedules or deferred exam schedules does not constitute grounds for consideration.

# Engineering Program Guide (Fall 2012- Winter 2013)

## FINAL EXAMS

### Final Exam Conflicts

**There is no legitimate reason for a student to have a timetable conflict during the final exam period.** It is the student's responsibility to check the final exam schedule for all of their courses during the Final Add Period immediately prior to the start of the semester. The final exam schedule is made available to students on Webadvisor approximately 4 weeks prior to the beginning of each semester. If a student identifies a final exam scheduling conflict, they are required to make adjustments to their course selections before the end of the final add period prior to the commencement of the semester. Exam conflicts usually occur when a student adds a course AFTER the exam schedule has been published, but they have neglected to check the exam dates at the time when they added the course. The final exam schedule is created based on student registrations from the course pre-selection periods.

If a student wishes to keep their course selections after identifying a final exam conflict, they are strongly advised to consult with the course instructor BEFORE the semester begins to request an alternate time to write the final exam. The course instructor is not obliged to grant the request and may require documentation from the student to verify the reason for the request.

If the instructor grants the request, it is the instructor's responsibility to personally accommodate the student within the official final exam period and before the instructor's deadline to submit final grades to the registrar for their individual course (typically, 7 days after the official date of the final exam). The start and end dates of the official final exam period are published in Section III, Schedule of Dates in the Undergraduate Calendar.

### Missed Final Exams

Missing a final exam is a serious academic situation. Students may be granted a deferred final exam ONLY if they have legitimate grounds for academic consideration.

The most common reason for missing a final exam is due to illness. Normally, the Academic Review Committee will not grant a deferred exam to a student who chooses to write a final exam, and then afterward states that their medical, psychological or compassionate condition impacted their performance on the exam.

If a student feels that their academic performance on a final exam is in jeopardy due to their medical, psychological or compassionate circumstances, it is the student's responsibility to consult their Program Counsellor as soon as possible so as to initiate action, and provide any required documentation.

**Medical documentation for a missed final exam should always be submitted directly to the Program Counsellor or Undergraduate Secretary.**

Requests for academic consideration for a missed final exam based upon psychological or compassionate grounds must be submitted to Undergraduate Program Services (UC Level 3) on an appropriately completed Request for Academic Consideration form, along with any supporting documentation. Please refer to the Undergraduate Calendar, VIII Undergraduate Degree Regulations and Procedures, Academic Consideration, Appeals and Petitions and/or the Academic Consideration section in this program guide for more information. <http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

Students who are ill on the day of a final exam are advised to visit the on-campus Student Health Services, an off-campus medical clinic, or Emergency Services at Guelph General Hospital before attempting to write a final exam. **Students, who state they were able to attend a final exam but were not able to seek medical services, will be denied academic consideration.** If you are ill and you choose to write your final exam while you are ill, you will not be granted a re-write even if medical documentation is provided after the fact.

## Engineering Program Guide (Fall 2012- Winter 2013)

If a student visits a physician off-campus, an off-campus medical form is required. The off-campus medical form, located on the SOE website and also printed in this Program Guide, must be filled out by the attending physician. It is the student's responsibility to ensure that the physician clearly provide all pertinent information regarding the effects of the medical condition that prevented the student from writing the exam, the date of the medical examination and, where applicable, the dates the student would have been severely or moderately affected.

The Academic Review Committee and/or the Program Counsellor have the right to deny medical consideration under one or more of the following conditions:

- Absence of an off-campus medical note or a medical note from Student Health Services.
- Apparent discrepancies in dates or the medical condition.
- The medical condition is deemed by the attending physician as being slight, negligible, or inconclusive.
- The medical examination is conducted after the symptoms of the illness have passed and the documentation is based solely on the student's description of the illness.

### *Procedures for the Fall Semester (ENGG courses only)*

Students who miss a final exam for an ENGG course or MATH\*2270 in the **fall semester only** are granted a deferred condition if appropriate documentation is provided to support their grounds for the request. The deferred condition for a missed final exam will be in the form of a two-hour exam to be written during the first week of classes of the subsequent winter semester. Exam schedules for "**Deferred Conditions**" are published on the School of Engineering website:  
<http://www.soe.uoguelph.ca/academic/pages/home.html>

Medical documentation must be submitted to the Program Counsellor before the first week of classes of the subsequent winter semester to be granted a deferred condition.

Students who are granted a deferred final exam for any other courses taken in the Fall Semester will write the deferred final exam during the scheduled deferred exam period as published in Section III, Schedule of Dates in the Undergraduate Calendar. Deferred final exam schedules will be posted on Webadvisor, as required.

### *Procedures for the Winter and Summer Semesters (all courses)*

Students who are granted a deferred final exam for any course taken in the Winter or Summer Semesters will write the deferred final exam during the scheduled deferred exam period as published in Section III, Schedule of Dates in the Undergraduate Calendar. Deferred final exam schedules will be posted on Webadvisor, as required.

## Deferred Final Exam Period

When a student makes a request for a deferred final exam, it is their responsibility to be prepared to write the exam during the scheduled deferred exam period as published in Section III, Schedule of Dates in the Undergraduate Calendar, or the scheduled deferred condition period posted on the SOE website, **regardless of when they receive confirmation from the registrar that the deferred exam or deferred condition was granted.**

The start and end dates of the scheduled deferred exam period are published in the Schedule of Dates in the Undergraduate Calendar. The deferred exam schedule will be posted on Webadvisor and the link will be communicated to the student via their uoguelph email account once the deferred exam schedule is finalized.

A student, who cannot attend their deferred exam or deferred condition, as scheduled, must make a request for academic consideration to receive an extension and they must have grounds for their request.

## Engineering Program Guide (Fall 2012- Winter 2013)

**Intentionally left blank to insert off-campus medical form in PDF format**

## Engineering Program Guide (Fall 2012- Winter 2013)

### FINAL DESIGN (41X)

All engineering students must successfully complete the capstone design project course associated with their engineering program in their final academic semester. Registration in 41X requires a pre-graduation check by the engineering program counsellor. **You cannot add 41X on Webadvisor.** Instructions for registration in 41X are available upon request from the program counsellor and are emailed to the undergraduate listserv at the beginning of the fall and winter course selection periods.

Students are responsible for creating their own design group of 3 or 4 students and for finding a faculty advisor for their project. **The faculty advisor MUST be a licensed Professional Engineer (P.Eng.). Students can search the SOE Faculty webpage to identify faculty members who have obtained P.Eng. status:** <http://www.uoguelph.ca/engineering/faculty>

### SCHEDULE OF STUDIES

Detailed course listings for each of the seven B.Eng. degree majors are provided in the following sections, including lists for program-specific electives and complementary studies electives. Information regarding prerequisite requirements, course credit weighting, semester offerings and any pertinent restrictions is also provided. Course requirements for the two B.Eng. minor programs are located at the end of this section.

Students should pay particular attention to the restrictions associated with entry into the 3<sup>rd</sup> and 4<sup>th</sup> year core design courses. In both cases, students in the B.Eng. program must have a minimum cumulative average of 60% in all ENGG courses to be permitted to register for ENGG\*3100 and 41X (i.e., ENGG\*4110, ENGG\*4120, ENGG\*4130, ENGG\*4150, ENGG\*4160, ENGG\*4170 and ENGG\*4180), collectively and commonly referred to as final design.

Students who do not achieve the 60% ENGG criterion by the end of Semester 4 should meet with the Program Counsellor to discuss their academic options. A cumulative tally of the ENGG course average is provided on your individual Academic Evaluation on your Webadvisor account.

**Engineering Program Guide (Fall 2012- Winter 2013)**

# Engineering Program Guide (Fall 2012- Winter 2013)

## Undeclared First Year Entry Semester 1 (All Majors)

### 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

### Prerequisites

4U Chemistry (or equivalent) or CHEM*1060
None
None
1 of 4U Calculus and Vectors, 4U Advanced Functions and Calculus

One of:

ENGG*1210	[0.50] Engineering Mechanics I	None
HIST*1250	[0.50] Science and Technology in a Global Context	None

In Semester 2, three groups of Majors have different courses in their Schedule of Studies. Undeclared students completing course selection for Semester 2 must decide which group of Majors most fits their interest area and make their course selection based on this decision.

## Semester 2 (All students)

### Semester 2 (Winter)

ENGG*1500	[0.50] Engineering Analysis
MATH*1210	[0.50] Calculus II
PHYS*1130	[0.50] Physics With Applications

### Prerequisites

MATH*1200
1 of MATH*1000, MATH*1080, MATH*1200
(MATH*1080 or MATH*1200), [1 of 4U Physics, (or equivalent), PHYS*1020]

One of:

ENGG*1210	[0.50] Engineering Mechanics I	None
HIST*1250	[0.50] Science and Technology in a Global Context	None

Students planning to declare the following majors will add:

### BIOE, BME, ENVE, WRE

CHEM*1040	[0.50] General Chemistry II	CHEM*1040
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### CENG, ESC

CIS*2500	[0.50] Intermediate Programming	CIS*1500; Equates: CIS*2650
PHYS*1010	[0.50] Introductory Electricity and Magnetism	(MATH*1080 or MATH*1200), [1 of 4U Physics, PHYS*1020]

### MECH

PHYS*1010	[0.50] Introductory Electricity and Magnetism	(MATH*1080 or MATH*1200), [1 of 4U Physics, PHYS*1020]
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## Engineering Program Guide (Fall 2012- Winter 2013)

### Undeclared First Year Entry

#### *Declaring your Major*

All undeclared engineering student must declare a Major before Semester 3. Students must complete an Undergraduate Schedule of Studies Change Request form (available in the Engineering Counselling Office or online at: [http://www.uoguelph.ca/registrar/undergraduate/files/undergrad\\_sched\\_change.pdf](http://www.uoguelph.ca/registrar/undergraduate/files/undergrad_sched_change.pdf)). Courses in Semester 4 will be restricted to students who have declared their Major.

Students are advised that when you declare your Major, it is effective in the current semester. Students are reminded to check the schedule of fees on the Student Financial Services website. Changes in fees will be retroactive to the beginning of the current semester. If you are unsure of the impact of the fee change, please make an appointment with a Program Counsellor.

Students who would like to join the Co-operative Education program after declaring their major must apply for admission to the Co-operative Education Office by May 1st before Semester 3. Admission to the Co-operative Education Program is competitive and is based on the student's academic standing in Semesters 1 and 2, as well as space in the program. Requirements for eligibility include full time registration in Semesters 1 and 2, and a minimum cumulative average of 70% at the completion of Semester 2. Applications are available at: <http://www.cecs.uoguelph.ca/students/alumni/co-op-education/current-co-op-students/forms> Completed forms should be submitted directly to the Co-operative Education Office, Trent Lane.

## Engineering Program Guide (Fall 2012- Winter 2013)

### Biological Engineering [Regular and Co-op]

#### BIOE/BIOE:C

#### Schedule of Studies

##### Semester 1 (Fall) 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

##### Prerequisites

4U Chemistry (or equivalent) or CHEM\*1060  
None  
None  
1 of 4U Calculus and Vectors, 4U Advanced Functions and Calculus

One of:

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

None  
None

##### Semester 2 (Winter) 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

##### Prerequisites

CHEM\*1040  
MATH\*1200  
1 of MATH\*1000, MATH\*1080, MATH\*1200  
(MATH\*1080 or MATH\*1200), [1 of 4U Physics, (or equivalent), PHYS\*1020]

One of:

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

None  
None

##### Semester 3 (Fall) Regular or Co-op

COOP*1100	[0.00] Intro to Co-operative Education
ENGG*2160	[0.50] Engineering Mechanics II
ENGG*2400	[0.50] Engineering Systems Analysis

##### Prerequisites

Co-op students only as requirement for entry into the first work term  
ENGG\*1210, ENGG\*1500, [0.50] credits in Calculus  
ENGG\*1210, ENGG\*1500, MATH\*1200, MATH\*1210, PHYS\*1130, Co-requisite MATH\*2270  
ENGG\*1500, MATH\*1210

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

4U Biology (or Grade 12 Biology) recommended  
4U Biology (or Grade 12 Biology) recommended

One of:

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

CHEM\*1040, PHYS\*1130  
ENGG\*1210, MATH\*1210

One of:

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

Completion of 4.0 credits including ENGG\*1100  
1 of IPS\*1510, MATH\*1210, MATH\*2080

##### Semester 4 (Winter) 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

##### Prerequisites

CHEM\*1050 or CHEM\*2300  
ENGG\*2400, (PHYS\*1010 or PHYS\*1130)  
ENGG\*2400, MATH\*2270, (1 of BIOL\*1030, BIOL\*1070, BIOL\*1080, BIOL\*1090 or MICR\*1020)  
1 of IPS\*1510, MATH\*1210, MATH\*2080

MATH\*2130 [0.50] Numerical Methods

One of:

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

CHEM\*1040, PHYS\*1130  
ENGG\*1210, MATH\*1210

One of:

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

Completion of 4.0 credits including ENGG\*1100  
1 of IPS\*1510, MATH\*1210, MATH\*2080

Schedule of Studies continued on next page...

# Engineering Program Guide (Fall 2012- Winter 2013)

## Biological Engineering [Regular and Coop]

### BIOE/BIOE:C

#### Schedule of Studies

##### Semester 5 (Fall) 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

##### Prerequisites

4U Biology (or Grade 12 Biology) recommended  
ENGG\*2230, ENGG\*2660  
ENGG\*2120  
MATH\*1210  
CHEM\*1040, ENGG\*2230, ENGG\*2400, MATH\*2270  
ENGG\*2450

##### Semester 6 (Winter) Regular or Semester 7 (Winter) Co-op

ENGG*3100	[0.75] Engineering and Design III
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##### Prerequisites

Registration in the B.Eng. program and completion of 6.00 credits of ENGG courses including ENGG\*2100  
**Students must have a minimum cumulative average of 60% in all ENGG courses for entry into ENGG\*3100. Restriction waiver requests are handled by the Director, School of Engineering, or designate.**

ENGG*3410	[0.50] Systems and Control Theory
ENGG*3430	[0.50] Heat and Mass Transfer
ELECTIVE	[1.00] Restricted Electives

ENGG\*2400, MATH\*2270, Co-requisite ENGG\*2450  
ENGG\*2230, ENGG\*3260, MATH\*2270

##### See elective lists

##### Semester 7 (Fall) Regular or Semester 6 (Fall) Co-op

ENGG*4390	[0.75] Bio-Instrumentation Design
ELECTIVE	[2.75] Restricted Electives

##### Prerequisites

ENGG\*3450

##### See elective lists

##### Semester 8 (Winter) Regular or Co-op

ENGG*4110	[1.00] Biological Engineering Design IV
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##### Prerequisites

All 1000 and 2000 level core credits plus ENGG\*3100. Must be enrolled in the B.Eng. Program. This course must be taken in the final semester with a maximum of 3.25 credits. Admission to the course is by instructor's permission in the semester prior to the course offering.

**Students must have a minimum cumulative average of 60% in all ENGG courses for entry into ENGG\*4110. Restriction waiver requests are handled by the Director, School of Engineering, or designate.**

ENGG*4280	[0.75] Digital Process Control Design
ELECTIVE	[1.00] Restricted Electives

ENGG\*3410

##### See elective lists

### *Biological Engineering Restricted Electives*

Biological engineering students must complete the following restricted electives. You can take these courses where Restricted Electives are indicated in the Schedule of Studies above.

**A maximum of 1.5 credits at the 1000 course level is allowed for elective requirements.**

[1.00] credit in Biological Engineering Electives in **List BIOE-1**

[0.75] credit in Biological Engineering Design Electives in **List BIOE-2**

[2.00] credits in Complementary Studies Electives in **Lists CS-1, CS-2 and CS-3**

(Complementary Studies elective list is located at the back of this program guide)

[1.00] credits in Free Elective

(MATH\*2150 Applied Matrix Algebra and MATH\*2160 Linear Algebra I cannot be used as free electives. The material is redundant for Biological Engineering students.)

All elective course offerings are subject to a minimum enrolment of 10 students. Courses may be cancelled by the university at any time if enrolment is less than 10. Semester offerings for courses may change without notice. Students should refer to the current Undergraduate Calendar to confirm that the course will be offered in the semester indicated in this program guide.

## Engineering Program Guide (Fall 2012- Winter 2013)

### Biological Engineering [Regular and Coop]

BIOE/BIOE:C

#### Schedule of Studies

##### List BIOE-1:

##### Biological Engineering Electives (1.0 Credit)

ENGG*2410 [0.50]	Digital Systems Design Using Descriptive Languages, F	(CIS*1650 or CIS*1500), PHYS*1130
ENGG*3150 [0.50]	Engineering Biomechanics, W	ENGG*2160
ENGG*3180 [0.50]	Air Quality, F	ENGG*2230, (ENGG*2560 or ENGG*2660) Co-requisite ENGG*3260
ENGG*3390 [0.50]	Signal Processing, F	ENGG*2400
ENGG*3590 [0.50]	Water Quality, F	ENGG*2230, ENGG*2560, (1 of BIOL*1040, BIOL*1090, MICR*2420 or MICR*1020), STAT*2120
ENGG*3640 [0.50]	Microcomputer Interfacing, F	ENGG*2410, ENGG*2450
ENGG*3830 [0.50]	Bio-Process Engineering, F	ENGG*2230, ENGG*2660 Co-requisite ENGG*3260
ENGG*4260 [0.75]	Water and Wastewater Treatment Design, W	ENGG*3100, ENGG*3590
ENGG*4300 [0.75]	Food Processing Engineering Design, F	ENGG*3260, ENGG*3830
ENGG*4340 [0.50]	Solid & Hazardous Waste Management, F	ENGG*2560 or ENGG*2660
ENGG*4380 [0.75]	Bioreactor Design, W	ENGG*3160
ENGG*4400 [0.75]	Biomechanical Engineering Design, F	ENGG*3150, ENGG*3170
ENGG*4510 [0.50]	Assessment & Management of Risk, W	STAT*2040 or STAT*2120
ENGG*4660 [0.50]	Medical Imaging Processing, W	ENGG*3390

##### List BIOE-2:

##### Biological Engineering Design Electives (0.75 Credits)

ENGG*4300 [0.75]	Food Processing Engineering Design, F	ENGG*3260, ENGG*3830
ENGG*4380 [0.75]	Bioreactor Design, W	ENGG*3160
ENGG*4400 [0.75]	Biomechanical Engineering Design, F	ENGG*3150, ENGG*3170

**Note: The courses in List BIOE-2 are also available in List BIOE-1. These courses cannot be counted towards more than one Elective List requirement.**

#### *Conditions for Graduation*

To qualify for the degree, the student must complete the courses required for the Bachelor of Engineering Program in Biological Engineering, 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.

**End of biological engineering program requirements for students following the 2012/13 Undergraduate Course Calendar.**

**Engineering Program Guide (Fall 2012- Winter 2013)**

## Engineering Program Guide (Fall 2012- Winter 2013)

### Biomedical Engineering [Regular and Coop]

#### BME/BME:C

#### Schedule of Studies

##### Semester 1 (Fall) 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

##### Prerequisites

4U Chemistry (or equivalent) or CHEM\*1060  
None  
None  
1 of 4U Calculus and Vectors, 4U Advanced Functions and Calculus

One of:

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

None  
None

##### Semester 2 (Winter) 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

##### Prerequisites

CHEM\*1040  
MATH\*1200  
1 of MATH\*1000, MATH\*1080, MATH\*1200  
(MATH\*1080 or MATH\*1200), [1 of 4U Physics, (or equivalent), PHYS\*1020]

One of:

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

None  
None

##### Semester 3 (Fall) Regular or Co-op

COOP*1100	[0.00] Intro to Co-operative Education
BIOL*1070	[0.50] Discovering Biodiversity
ENGG*2400	[0.50] Engineering Systems Analysis

##### Prerequisites

Co-op students only as requirement for entry into the first work term  
4U Biology (or Grade 12 Biology) recommended  
ENGG\*1210, ENGG\*1500, MATH\*1200, MATH\*1210, PHYS\*1130,  
Co-requisite MATH\*2270  
ENGG\*1500, MATH\*1210  
**See elective lists**

MATH*2270	[0.50] Applied Differential Equations
ELECTIVE	[0.50] Restricted Elective

One of:

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

Completion of 4.0 credits including ENGG\*1100  
1 of IPS\*1510, MATH\*1210, MATH\*2080

One of:

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

CHEM\*1040, PHYS\*1130  
ENGG\*1210, MATH\*1210

##### Semester 4 (Winter) Regular or Co-op

BIOL*1080	[0.50] Biological Concepts of Health
BIOM*2000	[0.50] Concepts in Physiology [1]
ENGG*2450	[0.50] Electric Circuits
MATH*2130	[0.50] Numerical Methods

##### Prerequisites

4U Biology (or Grade 12 Biology) recommended  
None  
ENGG\*2400, (PHYS\*1010 or PHYS\*1130)  
1 of IPS\*1510, MATH\*1210, MATH\*2080

One of:

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

Completion of 4.0 credits including ENGG\*1100  
1 of IPS\*1510, MATH\*1210, MATH\*2080

One of:

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

CHEM\*1040, PHYS\*1130  
ENGG\*1210, MATH\*1210

[1] Students pursuing the pharmaceutical series of electives may swap BIOM\*2000 Concepts in Physiology for ENGG\*2660 Biological Engineering Systems I in Semester 4. Students pursuing the biomechanics series of electives may swap BIOM\*2000 Concepts in Physiology for ENGG\*3150 Engineering Biomechanics in Semester 4. BIOM\*2000 Concepts in Physiology can then be taken in the elective slot of Semester 5.

Schedule of Studies continued on next page...

# Engineering Program Guide (Fall 2012- Winter 2013)

## Biomedical Engineering [Regular and Coop]

BME/BME:C

### Schedule of Studies

#### Semester 5 (Fall) Regular or Co-op

BIOM*3010	[0.50] Comparative Mammalian Anatomy
ENGG*3170	[0.50] Biomaterials
ENGG*3240	[0.50] Engineering Economics
ENGG*3260	[0.50] Thermodynamics
ENGG*3450	[0.50] Electrical Devices
ELECTIVE	[0.50] Restricted Elective

#### Prerequisites

BIOL\*1040 or (BIOL\*1070, BIOL\*1080)  
ENGG\*2120  
MATH\*1210  
CHEM\*1040, ENGG\*2230, ENGG\*2400, MATH\*2270  
ENGG\*2450

See elective lists

#### Semester 6 (Winter) Regular or Semester 7 (Winter) Co-op

ENGG\*3100 [0.75] Engineering and Design III

#### Prerequisites

Registration in the B.Eng. program and completion of 6.00 credits of ENGG courses including ENGG\*2100

**Students must have a minimum cumulative average of 60% in all ENGG courses for entry into ENGG\*3100. Restriction waiver requests are handled by the Director, School of Engineering, or designate.**

ENGG\*2400, MATH\*2270, Co-requisite ENGG\*2450  
1.5 credits in biology

See elective lists

ENGG\*3410 [0.50] Systems and Control Theory  
PATH\*3610 [0.50] Principles of Disease  
ELECTIVE [1.50] Restricted Electives

#### Semester 7 (Fall) Regular or Semester 6 (Fall) Co-op

ENGG\*4390 [0.75] Bio-Instrumentation Design  
ELECTIVE [2.00] Restricted Electives

#### Prerequisites

ENGG\*3450

See elective lists

#### Semester 8 (Winter) Regular or Co-op

ENGG\*3430 [0.50] Heat and Mass Transfer  
ENGG\*4180 [1.00] Biomedical Engineering Design IV

#### Prerequisites

ENGG\*2230, ENGG\*3260, MATH\*2270

All 1000 and 2000 level core credits plus ENGG\*3100. Must be enrolled in the B.Eng. Program. This course must be taken in the final semester with a maximum of 3.25 credits. Admission to the course is by instructor's permission in the semester prior to the course offering.

**Students must have a minimum cumulative average of 60% in all ENGG courses for entry into ENGG\*4180. Restriction waiver requests are handled by the Director, School of Engineering, or designate.**

See elective lists

ELECTIVE [1.25] Restricted Electives

### Biomedical Engineering Restricted Electives

Biomedical engineering students must complete the following restricted electives. You can take these courses where Restricted Electives are indicated in the Schedule of Studies above.

**A maximum of 1.5 credits at the 1000 course level is allowed for elective requirements.**

[3.00] credits in Biomedical Engineering Electives in **List BME-1**

[0.75] credit in Biomedical Engineering Design Electives in **List BME-2**

[2.00] credits in Complementary Studies Electives in **Lists CS-1, CS-2 and CS-3**

(Complementary Studies elective list is located at the back of this program guide)

Selection of the restricted elective courses available in Lists BME-1 and BME-2 should be based on each student's personal and professional interests. Students who wish to strengthen their knowledge in a particular area of interest can use the indicators provided in brackets beside each elective course as additional guidance, where (M) indicates courses related to biomechanics, (P) indicates courses related to pharmaceutical processing and (S) indicates courses related to biosignals.

## Engineering Program Guide (Fall 2012- Winter 2013)

### Biomedical Engineering [Regular and Coop]

BME/BME:C

#### Schedule of Studies

All elective course offerings are subject to a minimum enrolment of 10 students. Courses may be cancelled by the university at any time if enrolment is less than 10. Semester offerings for courses may change without notice. Students should refer to the current Undergraduate Calendar to confirm that the course will be offered in the semester indicated in this program guide.

#### List BME-1:

##### Biomedical Engineering Electives (3.0 Credits)

*A minimum of 0.5 credits must be selected from Part A*

*No more than 1.0 credit may be selected from Part C. Selection of courses from Part C is not mandatory.*

<b>Part A</b>		
ENGG*2160 [0.50] Engineering Mechanics, II, F (M)	Semester 3 recommended	ENGG*1210, ENGG*1500, 0.50 credits in calculus
ENGG*2660 [0.50] Biological Engineering Systems I, W, (P)	Semester 4 recommended	ENGG*2400, MATH*2270, (1 of BIOL*1030, BIOL*1070, BIOL*1080, BIOL*1090 or MICR*1020)
ENGG*3390 [0.50] Signal Processing, F (P)(S)	Semester 5 recommended	ENGG*2400
<b>Part B</b>		
ENGG*3150 [0.50] Engineering Biomechanics, W (M)		ENGG*2160 (Semester 4 recommended for Co-op)
ENGG*3160 [0.50] Biological Engineering Systems II, F (P)		ENGG*2230, ENGG*2660
ENGG*4040 [0.50] Medical Imaging Modalities, F (S)		MATH*1210, PHYS*1130
ENGG*4050 [0.50] Quality Control, W (P)		STAT*2120
ENGG*4060 [0.50] Biomedical Signals Processing, W (S)		ENGG*3390
ENGG*4660 [0.50] Medical Imaging Processing, W (S)		ENGG*3390
<b>Part C</b>		
BIOC*2580 [0.50] Introductory Biochemistry, S/F/W (P)		CHEM*1050 or CHEM*2300
BIOM*3090 [0.50] Principles of Pharmacology, W (P)		BIOC*2580, (1 of BIOM*3110, BIOM*3200, HK*3940, ZOO*3200)
HK*4240 [0.75] Occupational Biomechanics and Ergonomics, W (M)		1 of ENGG*1210, HK*3270, (HK*2270, HK*3600)
HK*4610 [0.50] Health and Injury Biomechanics, W (M)		ENGG*3150 or HK*2270
NANO*4100 [0.50] Biological Nanomaterials, F (P)(S)		NANO*2100
TOX*2000 [0.50] Principles of Toxicology, F (P)		(CHEM*1050 or CHEM*2300), (MATH*1080 or equivalent), (BIOL*1040 or BIOL*1080) (CHEM*2300 may be taken concurrently)

#### List BME-2:

##### Biomedical Engineering Design Electives (0.75 Credits)

ENGG*4280 [0.75] Digital Process Control Design, W (P)(S)	ENGG*3410
ENGG*4380 [0.75] Bioreactor Design, W (P)	ENGG*3160
ENGG*4400 [0.75] Biomechanical Engineering Design, F (M)	ENGG*3150, ENGG*3170



## Engineering Program Guide (Fall 2012- Winter 2013)

Biomedical Engineering [Regular and Coop]

BME/BME:C

Schedule of Studies

### *Conditions for Graduation*

To qualify for the degree, the student must complete the courses required for the Bachelor of Engineering Program in Biomedical Engineering, obtaining a minimum of 23.25 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.

**End of biomedical engineering program requirements for students following the 2012/13 Undergraduate Course Calendar.**

## Engineering Program Guide (Fall 2012- Winter 2013)

### Computer Engineering [Regular and Coop]

CENG/CENG:C

#### Schedule of Studies

##### Semester 1 (Fall) 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

##### Prerequisites

4U Chemistry (or equivalent) or CHEM\*1060  
None  
None  
1 of 4U Calculus and Vectors, 4U Advanced Functions and Calculus

One of:

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

None  
None

##### Semester 2 (Winter) 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

##### Prerequisites

CIS\*1500; Equates: CIS\*2650  
MATH\*1200  
1 of MATH\*1000, MATH\*1080, MATH\*1200  
(MATH\*1080 or MATH\*1200), [1 of 4U Physics, PHYS\*1020]  
(MATH\*1080 or MATH\*1200), [1 of 4U Physics, (or equivalent), PHYS\*1020]

One of:

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

None  
None

##### Semester 3 (Fall) Regular or Co-op

COOP*1100	[0.00] Intro to Co-operative Education
CIS*2430	[0.50] Object Oriented Programming
CIS*2520	[0.50] Data Structures
CIS*2910	[0.50] Discrete Structures in Computing II
ENGG*2400	[0.50] Engineering Systems Analysis

##### Prerequisites

Co-op students only as requirement for entry into the first work term  
CIS\*2500  
CIS\*2500, (1 of CIS\*1910 or ENGG\*1500) Equates: CIS\*2420  
CIS\*1500, (CIS\*1910 or ENGG\*1500)  
ENGG\*1210, ENGG\*1500, MATH\*1200, MATH\*1210, PHYS\*1130,  
Co-requisite MATH\*2270  
(CIS\*1650 or CIS\*1500), PHYS\*1130

ENGG*2410	[0.50] Digital Systems Design Using Descriptive Languages
MATH*2270	[0.50] Applied Differential Equations

(CIS\*1650 or CIS\*1500), PHYS\*1130  
ENGG\*1500, MATH\*1210

##### Semester 4 (Winter) 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
ELECTIVE	[0.50] Restricted Elective [1]

##### Prerequisites

Completion of 4.0 credits including ENGG\*1100  
ENGG\*2400, (PHYS\*1010 or PHYS\*1130)  
ENGG\*2410  
1 of IPS\*1510, MATH\*1210, MATH\*2080  
1 of IPS\*1510, MATH\*1210, MATH\*2080

**See elective lists**

[1] Students following the software engineering stream in List CENG-1 should take CIS\*2750 in Semester 4 of their program.

##### Semester 5 (Fall) 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
ELECTIVE	[1.00] Restricted Elective

##### Prerequisites

CHEM\*1040, PHYS\*1130  
MATH\*1210  
ENGG\*2450  
ENGG\*2410, ENGG\*2450  
**See elective lists**

Schedule of Studies continued on next page...

# Engineering Program Guide (Fall 2012- Winter 2013)

## Computer Engineering [Regular and Coop]

CENG/CENG:C

### Schedule of Studies

#### Semester 6 (Winter) Regular or Semester 7 (Winter) Co-op

CIS*3110	[0.50] Operating Systems
CIS*3490	[0.50] The Analysis and Design of Computer Algorithms
ENGG*3100	[0.75] Engineering and Design III

#### Prerequisites

(CIS\*2500 or CIS\*2650), Recommended (CIS\*2030 or ENGG\*2410) (CIS\*1900 or CIS\*2910), (CIS\*2420 or CIS\*2520)

Registration in the B.Eng. program and completion of 6.00 credits of ENGG courses including ENGG\*2100

**Students must have a minimum cumulative average of 60% in all ENGG courses for entry into ENGG\*3100. Restriction waiver requests are handled by the Director, School of Engineering, or designate.**

MATH\*2130, STAT\*2120

ENGG\*2400, MATH\*2270, Co-requisite ENGG\*2450

**See elective lists**

ENGG*3210	[0.50] Communication Systems
ENGG*3410	[0.50] Systems and Control Theory
ELECTIVE	[0.50] Restricted Electives

#### Semester 7 (Fall) Regular or Semester 6 (Fall) 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
ELECTIVE	[1.00] Restricted Electives

#### Prerequisites

ENGG\*3450

CIS\*3110 (effective F13, new prerequisites will be ENGG\*3640, ENGG\*2400)

(CIS\*2420 or CIS\*2520), ENGG\*2100

**See elective lists**

#### Semester 8 (Winter) Regular or Co-op

ENGG*4170	[1.00] Computer Engineering Design IV
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#### Prerequisites

All 1000 and 2000 level core credits plus ENGG\*3100. Must be enrolled in the B.Eng. Program. This course must be taken in the final semester with a maximum of 3.25 credits. Admission to the course is by instructor's permission in the semester prior to the course offering.

**Students must have a minimum cumulative average of 60% in all ENGG courses for entry into ENGG\*4170. Restriction waiver requests are handled by the Director, School of Engineering, or designate.**

ENGG\*3210, ENGG\*3380

ENGG\*2410, ENGG\*2450, ENGG\*3450

**See elective lists**

ENGG*4540	[0.50] Advanced Computer Architecture
ENGG*4550	[0.50] VLSI Digital Design
ELECTIVE	[1.00] Restricted Electives

### Computer Engineering Restricted Electives

Computer Engineering students must complete the following restricted electives. You can take these courses where Restricted Electives are indicated in the Schedule of Studies above.

**A maximum of 1.5 credits at the 1000 course level is allowed for elective requirements.**

[2.00] credits in Computer Engineering Electives in **List CENG-1**

[2.00] credits in Complementary Studies electives in **Lists CS-1, CS-2 and CS-3**

(Complementary Studies elective list is located at the back of this program guide)

## Engineering Program Guide (Fall 2012- Winter 2013)

### Computer Engineering [Regular and Coop]

CENG/CENG:C

#### Schedule of Studies

The Computer Engineering Program offers four streams for further specialization. These streams consist of elective courses in List CENG-1. The streams are: Electronic Design Automation (E), Microsystems (M), Robotics and AI (R) and Software (S).

Streams are optional. Students are free to mix and match between streams or pick any elective courses from List CENG-1. Students who wish to strengthen their knowledge in a particular specialization are encouraged to take all 2.00 credits from one stream. Streams have been noted beside each elective course below (in brackets) after the semester offering.

All elective course offerings are subject to a minimum enrolment of 10 students. Courses may be cancelled by the university at any time if enrolment is less than 10. Semester offerings for courses may change without notice. Students should refer to the current Undergraduate Calendar to confirm that the course will be offered in the semester indicated in this program guide.

#### List CENG-1:

##### Computer Engineering Electives (2.0 Credits)

CIS*2750	[0.75] Software Systems Development and Integration, W (S)	CIS*2430, CIS*2520 Restriction(s): CIS*2450
CIS*3700	[0.50] Introduction to Intelligent Systems, W (R)	(CIS*3750 or CIS*3760), (CIS*2460 or STAT*2040)
CIS*3750	[0.75] System Analysis and Design in Applications, F (S)	CIS*2750
CIS*3760	[0.75] Software Engineering, W (S)	CIS*2750, (CIS*3110 recommended)
CIS*4150	[0.50] Software Reliability and Testing, F (S)	CIS*3750 or CIS*3760
CIS*4720	[0.50] Image Processing and Vision, W, (R)	(CIS*2450 or CIS*2750), CIS*3110, (CIS*2460 or STAT*2040), (CIS*3700 recommended)
ENGG*3050	[0.50] Embedded Reconfigurable Computing Systems, W (E)(M)	ENGG*3380, ENGG*3450
ENGG*3190	[0.50] Logic Synthesis, W (E)	ENGG*2410
ENGG*3570	[0.50] MEMS and Microfabrication, F (M)	ENGG*2450, PHYS*1010
ENGG*3700	[0.50] Optimization for Engineers, F (E)	CIS*1500, MATH*2130, MATH*2270
ENGG*4430	[0.50] Neuro-Fuzzy and Soft Computing Systems, W (R)	ENGG*3410; Co-requisite ENGG*4280
ENGG*4460	[0.50] Robotic Systems, F (R)	ENGG*1500, ENGG*2400
ENGG*4560	[0.75] Embedded Systems Design, W (M)	ENGG*4550 Co-requisite: ENGG*3050
ENGG*4650	[0.50] Integrated Sensors and Photonic Devices, F (M)	CHEM*1040, ENGG*2450, PHYS*1010
ENGG*4720	[0.50] Physical Design Automation, W (E)	CIS*2500, CIS*3490, ENGG*3700

#### *Conditions for Graduation*

To qualify for the degree, the student must complete the courses required for the Bachelor of Engineering Program in Computer Engineering, obtaining a minimum of 24.00 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.

**End of computer engineering program requirements for students following the 2012/13 Undergraduate Course Calendar.**

**Engineering Program Guide (Fall 2012- Winter 2013)**

## Engineering Program Guide (Fall 2012- Winter 2013)

### Engineering Systems and Computing [Regular and Coop]

ESC/ESC:C

#### Schedule of Studies

##### Semester 1 (Fall) 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

##### Prerequisites

4U Chemistry (or equivalent) or CHEM\*1060  
None  
None  
1 of 4U Calculus and Vectors, 4U Advanced Functions and Calculus

One of:

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

None  
None

##### Semester 2 (Winter) 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

##### Prerequisites

CIS\*1500; Equates: CIS\*2650  
MATH\*1200  
1 of MATH\*1000, MATH\*1080, MATH\*1200  
(MATH\*1080 or MATH\*1200), [1 of 4U Physics, PHYS\*1020]  
(MATH\*1080 or MATH\*1200), [1 of 4U Physics, (or equivalent), PHYS\*1020]

One of:

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

None  
None

##### Semester 3 (Fall) Regular or Co-op

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

##### Prerequisites

Co-op students only as requirement for entry into the first work term  
CIS\*2500  
ENGG\*1210, ENGG\*1500, MATH\*1200, MATH\*1210, PHYS\*1130  
Co-requisite MATH\*2270  
(CIS\*1650 or CIS\*1500), PHYS\*1130  
ENGG\*1500, MATH\*1210

One of:

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

Completion of 4.0 credits including ENGG\*1100  
1 of IPS\*1510, MATH\*1210, MATH\*2080

One of:

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

CHEM\*1040, PHYS\*1130  
ENGG\*1210, MATH\*1210

##### Semester 4 (Winter) Regular or Co-op

CIS*3110	[0.50] Operating Systems
ENGG*2450	[0.50] Electric Circuits
MATH*2130	[0.50] Numerical Methods
ELECTIVE	[0.50] Restricted Elective

##### Prerequisites

(CIS\*2500 or CIS\*2650), Recommended (CIS\*2030 or ENGG\*2410)  
ENGG\*2400, (PHYS\*1010 or PHYS\*1130)  
1 of IPS\*1510, MATH\*1210, MATH\*2080  
**See elective lists**

One of:

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

Completion of 4.0 credits including ENGG\*1100  
1 of IPS\*1510, MATH\*1210, MATH\*2080

One of:

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

CHEM\*1040, PHYS\*1130  
ENGG\*1210, MATH\*1210

Schedule of Studies continued on next page...

# Engineering Program Guide (Fall 2012- Winter 2013)

## Engineering Systems and Computing [Regular and Coop]

ESC/ESC:C

### Schedule of Studies

#### Semester 5 (Fall) 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
ELECTIVE	[0.50] Restricted Elective

#### Prerequisites

CIS\*2500, (CIS\*1910 or ENGG\*1500) Equates: CIS\*2420  
CHEM\*1040, ENGG\*2230, ENGG\*2400, MATH\*2270  
ENGG\*2400  
ENGG\*2450  
ENGG\*2410, ENGG\*2450  
**See elective lists**

#### Semester 6 (Winter) Regular or Semester 7 (Winter) 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
ELECTIVE	[1.00] or [1.25] Restricted Electives [1]

#### Prerequisites

Registration in the B.Eng. program and completion of 6.00 credits of ENGG courses including ENGG\*2100  
**Students must have a minimum cumulative average of 60% in all ENGG courses for entry into ENGG\*3100. Restriction waiver requests are handled by the Director, School of Engineering, or designate.**  
ENGG\*2400, MATH\*2270, Co-requisite ENGG\*2450  
ENGG\*2230, ENGG\*3260, MATH\*2270  
**See elective lists**

[1] If ENGG\*3490 [0.75] is selected from List ESC-2 to meet the Engineering Design Elective Requirement, then the elective count will total 1.25 credits in Semester 6 (Reg) / 7 (Coop). Otherwise, the elective count will be 1.0 credit. Alternatively, the Engineering Design Elective ENGG\*4390 [0.75] can be taken in Semester 7 (Reg) / 6 (Coop), or ENGG\*3490 in Semester 8.

#### Semester 7 (Fall) Regular or Semester 6 (Fall) 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
ELECTIVE	[1.00] or [1.25] Restricted Electives [2]

#### Prerequisites

MATH\*1210  
CIS\*3110 (effective F13 new prerequisites will be ENGG\*3640, ENGG\*2400)  
(CIS\*2420 or CIS\*2520), ENGG\*2100  
**See elective lists**

[2] If ENGG\*4390 [0.75] is selected from List ESC-2 to meet the Engineering Design Elective Requirement, then the elective count will total 1.25 credits in Semester 7 (Reg) / 6 (Coop). Otherwise, the elective count will be 1.0 credit. Alternatively, the Engineering Design Elective, ENGG\*3490 [0.75] can be taken in either Semester 6 (Reg) / 7 (Coop) or Semester 8.

#### Semester 8 (Winter) Regular or Co-op

ENGG*4120	[1.00] Engineering Systems and Computing Design IV
ENGG*4280	[0.75] Digital Process Control Design
ELECTIVE	[1.00] or [1.25] Restricted Electives [3]

#### Prerequisites

All 1000 and 2000 level core credits plus ENGG\*3100. Must be enrolled in the B.Eng. Program. This course must be taken in the final semester with a maximum of 3.25 credits. Admission to the course is by instructor's permission in the semester prior to the course offering.  
**Students must have a minimum cumulative average of 60% in all ENGG courses for entry into ENGG\*4120. Restriction waiver requests are handled by the Director, School of Engineering, or designate.**  
ENGG\*3410  
**See elective lists**

[3] If ENGG\*3490 [0.75] is selected from List ESC-2 to meet the Engineering Design Elective Requirement, then the elective count will total 1.25 credits in Semester 8. Otherwise, the elective count will be 1.0 credit. The Engineering Design Elective ENGG\*3490 [0.75] can be taken in Semester 6 (Reg) / 7 (Coop), or ENGG\*4390 in Semester 7 (Reg) / 6 (Coop).

## Engineering Program Guide (Fall 2012- Winter 2013)

### Engineering Systems and Computing [Regular and Coop]

ESC/ESC:C

#### Schedule of Studies

##### *Engineering Systems and Computing Restricted Electives*

Engineering Systems & Computing students must complete the following restricted electives. You can take these courses where Restricted Electives are indicated in the Schedule of Studies above.

**A maximum of 1.5 credits at the 1000 course level is allowed for elective requirements.**

[1.50] credits in ES&C Engineering Electives in **List ESC-1**

[0.75] credits in ES&C Engineering Design Electives in **List ESC-2**

[2.00] credits in Complementary Studies electives in **Lists CS-1, CS-2 and CS-3**

(Complementary Studies elective list is located at the back of this program guide)

The ES&C Program offers four streams for further specialization. These streams consist of elective courses in List ESC-1 and ESC-2. The streams are: Mechatronics (M), Biomedical (B), Embedded Systems (E) and Computing (C). Students who wish to strengthen their knowledge in a particular specialization are encouraged to take all 2.25 credits from one stream. Streams have been noted beside each elective course. Streams are optional and students are free to mix and match between streams or pick any elective courses from List ESC-1 and ESC-2 to complete the required elective credit.

All elective course offerings are subject to a minimum enrolment of 10 students. Courses may be cancelled by the university at any time if enrolment is less than 10. Semester offerings for courses may change without notice. Students should refer to the current Undergraduate Calendar to confirm that the course will be offered in the semester indicated in this program guide.

#### **List ESC-1:**

##### **ES&C Engineering Electives (1.50 Credits)**

ENGG*3050	[0.50]	Embedded Reconfigurable Computing Systems, W (E)	ENGG*3380, ENGG*3450
ENGG*3380	[0.50]	Computer Organization and Design, W (M)	ENGG*2410
ENGG*4080	[0.50]	Micro and Nano-Scale Electronics, F (E)	ENGG*3450
ENGG*4430	[0.50]	Neuro-Fuzzy and Soft Computing Systems, W (M)	ENGG*3410; Co-requisite ENGG*4280
ENGG*4460	[0.50]	Robotic Systems, F (M)	ENGG*1500, ENGG*2400
ENGG*4550	[0.50]	VLSI Digital Design, W (E)	ENGG*2410, ENGG*2450, ENGG*3450
ENGG*4660	[0.50]	Medical Image Processing, W (B)	ENGG*3390
BIOM*2000	[0.50]	Concepts in Human Physiology, S/F/W (B)	None
PSYC*2390	[0.50]	Principles of Sensation and Perception, F/W (B)	PSYC*1100
CIS*2750	[0.75]	Software Systems Development and Integration, W (C)	CIS*2430, CIS*2520 Restriction(s): CIS*2450
CIS*3210	[0.50]	Computer Networks, F (C)	CIS*3110; Restriction(s): CIS*4200
CIS*3490	[0.50]	The Analysis and Design of Computer Algorithms, W (C)	(CIS*1900 or CIS*2910) , (CIS*2420 or CIS*2520)
CIS*4210	[0.50]	Telecommunications, W (C)	CIS*3750 or CIS*3760; Restriction(s): CIS*4200



## Engineering Program Guide (Fall 2012- Winter 2013)

Engineering Systems and Computing [Regular and Coop]

ESC/ESC:C

Schedule of Studies

### List ESC-2:

#### ES&C Engineering Design Electives (0.75 Credits)

ENGG*3490 [0.75]	Introduction to Mechatronic Systems Design, W (M)	ENGG*3450; Co-requisite: ENGG*3410 Restriction: ENGG*3400
ENGG*4390 [0.75]	Bio-Instrumentation Design, F (B)	ENGG*3450

### *Conditions for Graduation*

To qualify for the degree, the student must complete the courses required for the Bachelor of Engineering Program in Engineering Systems and Computing, 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.

**End of engineering systems and computing program requirements for students following the 2012/13 Undergraduate Course Calendar.**

## Engineering Program Guide (Fall 2012- Winter 2013)

### Environmental Engineering [Regular and Coop]

ENVE/ENVE:C

#### Schedule of Studies

##### Semester 1 (Fall) 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

##### Prerequisites

4U Chemistry (or equivalent) or CHEM\*1060  
 None  
 None  
 1 of 4U Calculus and Vectors, 4U Advanced Functions and Calculus

One of:

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

None  
 None

##### Semester 2 (Winter) 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

##### Prerequisites

CHEM\*1040  
 MATH\*1200  
 1 of MATH\*1000, MATH\*1080, MATH\*1200  
 (MATH\*1080 or MATH\*1200), [1 of 4U Physics, (or equivalent),  
 PHYS\*1020]

One of:

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

None  
 None

##### Semester 3 (Fall) Regular or Co-op

COOP\*1100 [0.00] Intro to Co-operative Education  
 ENGG\*2400 [0.50] Engineering Systems Analysis

##### Prerequisites

Co-op students only as requirement for entry into the first work term  
 ENGG\*1210, ENGG\*1500, MATH\*1200, MATH\*1210, PHYS\*1130  
 Co-requisite MATH\*2270  
 ENGG\*1500, MATH\*1210

MATH\*2270 [0.50] Applied Differential Equations  
 ELECTIVE [0.50] Restricted Elective

**See elective lists**

One of:

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

4U Biology (or Grade 12 Biology) recommended

4.00 credits including one of BIOL\*1070, BIOL\*1080, BIOL\*1090,  
 CHEM\*1040

One of:

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

Completion of 4.0 credits including ENGG\*1100  
 1 of IPS\*1510, MATH\*1210, MATH\*2080

One of:

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

CHEM\*1040, PHYS\*1130  
 ENGG\*1210, MATH\*1210

##### Semester 4 (Winter) Regular or Co-op

ENGG\*2450 [0.50] Electric Circuits  
 ENGG\*2560 [0.50] Environmental Engineering Systems  
 MATH\*2130 [0.50] Numerical Methods  
 ELECTIVE [0.50] Restricted Elective

##### Prerequisites

ENGG\*2400, (PHYS\*1010 or PHYS\*1130)  
 CHEM\*1050, MATH\*2270  
 1 of IPS\*1510, MATH\*1210, MATH\*2080

**See elective lists**

One of:

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

Completion of 4.0 credits including ENGG\*1100  
 1 of IPS\*1510, MATH\*1210, MATH\*2080

One of:

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

CHEM\*1040, PHYS\*1130  
 ENGG\*1210, MATH\*1210

Schedule of Studies continued on next page...

# Engineering Program Guide (Fall 2012- Winter 2013)

## Environmental Engineering [Regular and Coop]

ENVE/ENVE:C

### Schedule of Studies

#### Semester 5 (Fall) 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

ELECTIVE [0.50] Restricted Elective

#### Prerequisites

ENGG\*2230, (ENGG\*2560 or ENGG\*2660), Co-requisite ENGG\*3260  
MATH\*1210  
CHEM\*1040, ENGG\*2230, ENGG\*2400, MATH\*2270  
ENGG\*2230, ENGG\*2560, (1 of BIOL\*1040, BIOL\*1090 or MICR\*2420),  
STAT\*2120  
(ENGG\*2230 or MET\*2030), (MATH\*1210 or MATH\*2080), (STAT\*2120  
or STAT\*2040) and competency in computing

**See elective lists**

#### Semester 6 (Winter) Regular or Semester 7 (Winter) 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

ELECTIVE [1.00] Restricted Electives

#### Prerequisites

Registration in the B.Eng. program and completion of 6.00 credits of  
ENGG courses including ENGG\*2100

**Students must have a minimum cumulative average of 60% in all  
ENGG courses for entry into ENGG\*3100. Restriction waiver  
requests are handled by the Director, School of Engineering, or  
designate.**

ENGG\*2400, MATH\*2270, Co-requisite ENGG\*2450

ENGG\*2230, ENGG\*3260, MATH\*2270

ENGG\*2230, ENGG\*3260, MATH\*2270, Co-requisite ENGG\*3430

**See elective lists**

#### Semester 7 (Fall) Regular or Semester 6 (Fall) Co-op

ENGG\*3670 [0.50] Soil Mechanics

ENGG\*4330 [0.75] Air Pollution Control

ENGG\*4340 [0.50] Solid & Hazardous Waste Management

ENGG\*4370 [0.75] Urban Water Systems Design

ELECTIVE [0.50] Restricted Elective

#### Prerequisites

ENGG\*2120, ENGG\*2230

ENGG\*3180, ENGG\*3260

ENGG\*2560 or ENGG\*2660

ENGG\*2230, ENGG\*3650

**See elective lists**

#### Semester 8 (Winter) Regular or Co-op

ENGG\*4130 [1.00] Environmental Engineering Design IV

#### Prerequisites

All 1000 and 2000 level core credits plus ENGG\*3100. Must be enrolled  
in the B.Eng. Program. This course must be taken in the final semester  
with a maximum of 3.25 credits. Admission to the course is by instructor's  
permission in the semester prior to the course offering.

**Students must have a minimum cumulative average of 60% in all  
ENGG courses for entry into ENGG\*4130. Restriction waiver  
requests are handled by the Director, School of Engineering, or  
designate.**

ENGG\*3100, ENGG\*3590

1 of IPS\*1110, MATH\*1000, MATH\*1080, MATH\*1200

**See elective lists**

ENGG\*4260 [0.75] Water & Wastewater Treatment Design

ENVS\*3060 [0.50] Groundwater

ELECTIVE [0.50] Restricted Elective

### Environmental Engineering Electives

Environmental engineering students must complete the following restricted electives. You can take these courses where Restricted Electives are indicated in the Schedule of Studies above.

**A maximum of 1.5 credits at the 1000 course level is allowed for elective requirements.**

[1.50] credits in Environmental Engineering Electives in **List ENVE-1**

[2.00] credits in Complementary Studies Electives in **Lists CS-1, CS-2 and CS-3**

(Complementary Studies elective list is located at the back of this program guide)

The Environmental Engineering Elective courses in List ENVE-1 have been organized into areas of emphasis. Students who wish to strengthen their knowledge in a particular area of interest are encouraged to take all 1.5 credits from one section. Students are also free to mix and match courses from more than one area.

## Engineering Program Guide (Fall 2012- Winter 2013)

### Environmental Engineering [Regular and Coop]

ENVE/ENVE:C

#### Schedule of Studies

Elective courses from List ENVE-1 in combination with elective courses from the Complementary Studies lists may help students to pursue a Minor offered by other departments of the University. Please see the Undergraduate Calendar for a listing of Minors that are available. If you are interested in adding a Minor, check with the engineering program counsellor before you begin selecting elective courses for your Environmental Engineering Major.

All elective course offerings are subject to a minimum enrolment of 10 students. Courses may be cancelled by the university at any time if enrolment is less than 10. Semester offerings for courses may change without notice. Students should refer to the current Undergraduate Calendar to confirm that the course will be offered the semester indicated in this program guide.

#### List ENVE-1:

##### Environmental Engineering Electives (1.5 Credits)

<b>Engineering</b>			
ENGG*2160	[0.50]	Engineering Mechanics II, F	ENGG*1210, ENGG*1500, 0.50 credits in calculus
ENGG*3340	[0.50]	Geographic Information Systems in Environmental Engineering, F	(CIS*1500 or CIS*1600), (1 of MATH*1000, MATH*1080, MATH*1200)
ENGG*3450	[0.50]	Electrical Devices, F	ENGG*2450
ENGG*4250	[0.75]	Watershed Systems Design, W	ENGG*2230, ENGG*3650
ENGG*4280	[0.75]	Digital Processing Control Design, W	ENGG*3410
ENGG*4510	[0.50]	Assessment & Management of Risk, W	STAT*2040 or STAT*2120
<b>Business</b>			
ACCT*2220	[0.50]	Financial Accounting, F/W	1 of ECON*1050, ECON*1100, ENGG*3240
ACCT*2230	[0.50]	Management Accounting, F/W	1 of AGE*2220, ACCT*2220, or BUS*2220
MCS*1000	[0.50]	Introductory Marketing, S/F/W	None
MCS*3000	[0.50]	Advanced Marketing, F	10.00 credits including MCS*1000
<b>International Development</b>			
ECON*2650	[0.50]	Introductory Development Economics, F	ECON*1050, ECON*1100
ECON*3720	[0.50]	History of the World Economy Since 1850, U	ECON*1050, ECON*1100, (1 of ECON*2310, EURO*2070, HIST*2450, HUMN*2070, IDEV*2010, IDEV*2500)
ECON*3730	[0.50]	Europe and the World Economy to 1914, U	ECON*1050, ECON*1100, (1 of ECON*2310, EURO*1050, EURO*2070, HIST*2450, HUMN*2070, IDEV*2010, IDEV*2500)
GEOG*2030	[0.50]	Political Ecology & Geography, F	5.00 credits, GEOG*1220 is recommended
SOAN*3680	[0.50]	Perspectives on Development, F	1 of ANTH*2160, IDEV*2010, IDEV*2500, SOC*2080
POLS*3670	[0.50]	Comparative Public Policy and Administration, W	1 of IDEV*2010, IDEV*2500, POLS*2080, POLS*2100, POLS*2250
POLS*3790	[0.50]	The Political Economy of International Relations, W	1 of IDEV*2010, IDEV*2500, POLS*2080, POLS*2100, POLS*2200
<b>Science</b>			
BIOC*2580	[0.50]	Introduction to Biochemistry, S/F/W	CHEM*1050 or CHEM*2300
BIOL*1070	[0.50]	Discovering Biodiversity, F/W	None
BIOL*1080	[0.50]	Biological Concepts of Health, F/W	None

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## Engineering Program Guide (Fall 2012- Winter 2013)

### Environmental Engineering [Regular and Coop]

ENVE/ENVE:C

### Schedule of Studies

#### List ENVE-1 (Continued):

#### Environmental Engineering Electives (1.5 Credits)

Science			
BIOL*1090	[0.50]	Intro to Molecular and Cellular Biology, F/W	None
BIOL*2060	[0.50]	Ecology, F/W	4.00 credits including (BIOL*1040 or BIOL*1070)
BIOL*3110	[0.50]	Population Ecology, F/W	(MATH*1080 or MATH*1200), STAT*2040
BIOL*3450	[0.50]	Introduction to Aquatic Environments, F	(BIOL*1040 or BIOL*1070), CHEM*1050, (1 of IBIO*2300, ZOO*2070, ZOO*2700 strongly recommended)
BIOM*2000	[0.50]	Concepts in Human Physiology, S/F/W	None
CHEM*2480	[0.50]	Analytical Chemistry I, S/F/W	CHEM*1050
CHEM*2700	[0.50]	Organic Chemistry I, S/W	CHEM*1050
CIS*2500	[0.50]	Intermediate Programming, W	CIS*1500
CROP*2280	[0.50]	Crops in Land Reclamation, F	None
ENVS*1060	[0.50]	Principles of Geology, S/F/W	None
ENVS*2030	[0.50]	Meteorology and Climatology, F	1 of ENVS*2020, MET*2020, PHYS*1000, PHYS*1070, PHYS*1080, PHYS*1110, PHYS*1130
FOOD*2010	[0.50]	Principles of Food Science, S/W	None
GEOG*1300 OR	[0.50]	Intro to the Biophysical Environment, F/W	None; Restriction: GEOG*1350
GEOG*1350	[0.50]	Earth: Hazards and Global Change F,W	None; Restriction: GEOG*1300
GEOG*2110	[0.50]	Climate and the Biophysical Environment, W	GEOG*1300 or GEOG*1350
GEOG*2210	[0.50]	Environment & Resources, W	GEOG*1220 is recommended
GEOG*2420	[0.50]	The Earth From Space, F	0.50 credits in geography and/or earth science
GEOG*3420	[0.50]	Remote Sensing of the Environment, W	10.00 credits including GEOG*1300
MATH*4430	[0.50]	Advanced Numerical Methods, F	MATH*2130, (MATH*2150 or MATH*2160), MATH*2200, (MATH*2170 or MATH*2270)
MICR*2030	[0.50]	Microbial Growth, S/F/W	4.00 credits including (BIOL*1040 or BIOL*1090)
MICR*4180	[0.50]	Microbial Processes in Environmental Management, F	BIOC*2580, [BIOL*1040 or (2 of BIOL*1070, BIOL*1080, BIOL*1090)]
POPM*3240	[0.50]	Epidemiology, F	(1 of BIOL*1040, BIOL*1080 or BIOL*1090), STAT*2040
TOX*2000	[0.50]	Principles of Toxicology, F	(CHEM*1050 or CHEM*2300), (MATH*1080 or equivalent), (BIOL*1040 or BIOL*1080) (CHEM*2300 may be taken concurrently)

#### *Conditions for Graduation*

To qualify for the degree, the student must complete the courses required for the Bachelor of Engineering Program in Environmental Engineering, 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.

**End of environmental engineering program requirements for students following the 2012/13 Undergraduate Course Calendar.**

## Engineering Program Guide (Fall 2012- Winter 2013)

### Mechanical Engineering [Regular and Coop]

#### MECH/MECH:C

#### Schedule of Studies

##### Semester 1 (Fall) 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

##### Prerequisites

4U Chemistry (or equivalent) or CHEM*1060
None
None
1 of 4U Calculus and Vectors, 4U Advanced Functions and Calculus

One of:

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

None
None

##### Semester 2 (Winter) 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

##### Prerequisites

MATH*1200
1 of MATH*1000, MATH*1080, MATH*1200
(MATH*1080 or MATH*1200), [1 of 4U Physics, PHYS*1020]
(MATH*1080 or MATH*1200), [1 of 4U Physics, (or equivalent), PHYS*1020]

One of:

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

None
None

##### Semester 3 (Fall) Regular or Co-op

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

##### Prerequisites

Co-op students only as requirement for entry into the first work term
ENGG*1210, ENGG*1500, [0.50] credits in Calculus
ENGG*1210, ENGG*1500, MATH*1200, MATH*1210, PHYS*1130
Co-requisite MATH*2270
MATH*1210
ENGG*1500, MATH*1210

One of:

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

Completion of 4.0 credits including ENGG*1100
1 of IPS*1510, MATH*1210, MATH*2080

One of:

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

CHEM*1040, PHYS*1130
ENGG*1210, MATH*1210

##### Semester 4 (Winter) Regular or Co-op

ENGG*2340	[0.50] Kinematics and Dynamics
ENGG*2450	[0.50] Electric Circuits
MATH*2130	[0.50] Numerical Methods
ELECTIVE	[0.50] Restricted Elective [1]

##### Prerequisites

ENGG*2160
ENGG*2400, (PHYS*1010 or PHYS*1130)
1 of IPS*1510, MATH*1210, MATH*2080

**See elective lists**

One of:

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

Completion of 4.0 credits including ENGG*1100
1 of IPS*1510, MATH*1210, MATH*2080

One of:

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

CHEM*1040, PHYS*1130
ENGG*1210, MATH*1210

**[1]** Students planning to take ENGG\*4400 as their MECH-2 design elective in Semester 7Reg/6 Co-op, should take ENGG\*3150 as their MECH-1 elective in Semester 4.

Schedule of Studies continued on next page...

## Engineering Program Guide (Fall 2012- Winter 2013)

### Mechanical Engineering [Regular and Coop]

#### MECH/MECH:C

#### Schedule of Studies

##### Semester 5 (Fall) 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
ELECTIVE	[0.50] Restricted Elective <b>[2]</b>

##### Prerequisites

(CIS\*1650 or CIS\*1500), PHYS\*1130  
 CHEM\*1040, ENGG\*2230, ENGG\*2400, MATH\*2270  
 ENGG\*2120, ENGG\*2230, ENGG\*2340, ENGG\*2400, ENGG\*2450  
 ENGG\*2450  
 ENGG\*2160, ENGG\*2450, PHYS\*1010  
**See elective lists**

**[2]** Students planning to take ENGG\*4580 as their MECH-2 design elective in Semester 8 should take ENGG\*3080 as their MECH-1 elective in Semester 5.  
 Students planning to take ENGG\*4400 as their MECH-2 design elective in Semester 7 Reg/6 Co-op should take ENGG\*3170 as their MECH-1 elective in Semester 5.

##### Semester 6 (Winter) Regular or Semester 7 (Winter) Co-op

ENGG*1070	[0.25] Occupational Health and Safety
ENGG*3100	[0.75] Engineering and Design III

##### Prerequisites

10.00 credits, must be enrolled in B.Eng. Program.  
 Registration in the B.Eng. program and completion of 6.00 credits of ENGG courses including ENGG\*2100  
**Students must have a minimum cumulative average of 60% in all ENGG courses for entry into ENGG\*3100. Restriction waiver requests are handled by the Director, School of Engineering, or designate.**  
 ENGG\*2230, ENGG\*3260, co-requisite ENGG\*3430  
 ENGG\*2400, MATH\*2270, co-requisite ENGG\*2450  
 ENGG\*2230, ENGG\*3260, MATH\*2270  
**See elective lists**

ENGG*3370	[0.50] Applied Fluids and Thermodynamics
ENGG*3410	[0.50] Systems and Control Theory
ENGG*3430	[0.50] Heat and Mass Transfer
ELECTIVE	[0.50] Restricted Electives <b>[3]</b>

**[3]** Students planning to take ENGG\*4030 as their MECH-2 design elective in Semester 8, should take ENGG\*3120 as their MECH-1 elective in Semester 6 Reg/7 Co-op.  
 Students planning to take ENGG\*4580 as their MECH-2 design elective in Semester 8, should take ENGG\*3250 as their MECH-1 elective in Semester 6 Reg/7 Co-op.  
 Students planning to take ENGG\*4480 as their MECH-2 design elective in Semester 8, should take ENGG\*3490 as their MECH-1 elective in Semester 6 Reg/7 Co-op.

##### Semester 7 (Fall) Regular or Semester 6 (Fall) Co-op

ELECTIVE	[2.50] or [2.75] Restricted Electives <b>[4]</b>
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##### Prerequisites

**See elective lists**

**[4]** Students planning to take ENGG\*4030 as their MECH-2 design elective in Semester 8, should take ENGG\*3070 and ENGG\*4460 as their MECH-1 electives in Semester 7 Reg/6 Co-op.  
 Students planning to take ENGG\*4480 as their MECH-2 design elective in Semester 8, should take ENGG\*3640 and ENGG\*4460 as their MECH-1 electives in Semester 7 Reg/6 Co-op.  
 Students planning to take ENGG\*4580 as their MECH-2 design elective in Semester 8, should take ENGG\*4230 as their MECH-1 elective in Semester 7 Reg/6 Co-op.

Schedule of Studies continued on next page...

# Engineering Program Guide (Fall 2012- Winter 2013)

## Mechanical Engineering [Regular and Coop]

MECH/MECH:C

### Schedule of Studies

#### Semester 8 (Winter) Regular or Co-op

ENGG\*4160 [1.00] Mechanical Engineering Design IV

#### Prerequisites

All 1000 and 2000 level core credits plus ENGG\*3100. Must be enrolled in the B.Eng. Program. This course must be taken in the final semester with a maximum of 3.25 credits. Admission to the course is by instructor's permission in the semester prior to the course offering.

**Students must have a minimum cumulative average of 60% in all ENGG courses for entry into ENGG\*4160. Restriction waiver requests are handled by the Director, School of Engineering, or designate.**

**See elective lists**

ELECTIVE [2.00] or [2.25] Restricted Electives [5]

[5] Students planning to take ENGG\*4030 as their MECH-2 design elective in Semester 8, must take ENGG\*4050 and ENGG\*4280 as their MECH-1 electives in Semester 8.

### Mechanical Engineering Restricted Electives

Mechanical Engineering students must complete the following restricted electives. You can take these courses where restricted electives are indicated in the Schedule of Studies above.

**A maximum of 1.5 credits at the 1000 course level is allowed for elective requirements.**

[3.50] credits in Mechanical Engineering Electives in **List MECH-1**

[0.75] credits in Mechanical Engineering Design Electives in **List MECH-2**

[2.00] credits in Complementary Studies electives in **Lists CS-1, CS-2 and CS-3**

(Complementary Studies elective list is located at the back of this program guide)

All elective course offerings are subject to a minimum enrolment of 10 students. Courses may be cancelled by the university at any time if enrolment is less than 10. Semester offerings for courses may change without notice. Students should refer to the current Undergraduate Calendar to confirm that the course will be offered in the semester indicated in this program guide.

The restricted elective requirements in the Mechanical Engineering program have been designed to allow students to develop a broad foundation in mechanical engineering topics, or to focus on a specific area of interest. Students who seek a broadening approach are encouraged to select **ENGG\*4220 Interdisciplinary Mechanical Engineering Design** from List MECH-2 in the final semester of their program.

Students who seek a more specialized approach are encouraged to select one of the specialized design elective courses from List MECH-2. It is important to note that some of the prerequisite course requirements for the specialized design electives are included in the Engineering Elective List MECH-1. These courses must be taken to gain registration access to the design elective course. The table on the following page provides guidance for selecting elective courses from MECH-1 associated with each of the specialized design electives.



## Engineering Program Guide (Fall 2012- Winter 2013)

Mechanical Engineering [Regular and Coop]

MECH/MECH:C

Schedule of Studies

### Suggested Elective Course Sequencing

List MECH-2 Chose ENGG*4220, Or one of:	List MECH-1 Suggested Elective Sequence for prerequisites and co-requisites
ENGG*4030 (Semester 8) Manufacturing Systems Design	ENGG*3120 (Semester 6 Regular, Semester 7 Co-op) ENGG*3070 (Semester 7 Regular, Semester 6 Co-op) ENGG*4460 (Semester 7 Regular, Semester 6 Co-op)) ENGG*4050 (Semester 8) ENGG*4280 (Semester 8)
ENGG*4580 (Semester 8) Sustainable Energy Systems Design	ENGG*3080 (Semester 5) ENGG*3250 (Semester 6 Regular, Semester 7 Co-op) ENGG*4230 (Semester 7 Regular, Semester 6 Co-op)
ENGG*4400 (Semester 7) Biomechanical Engineering Design	ENGG*3150 (Semester 4) ENGG*3170 (Semester 5)
ENGG*4480 (Semester 8) Advanced Mechatronic System Design	ENGG*3490 (Semester 6 Regular, Semester 7 Co-op) ENGG*3640 (Semester 7 Regular, Semester 6 Co-op) ENGG*4460 (Semester 7 Regular, Semester 6 Co-op)

## Engineering Program Guide (Fall 2012- Winter 2013)

### Mechanical Engineering [Regular and Coop]

MECH/MECH:C

#### Schedule of Studies

##### List MECH-1:

##### Mechanical Engineering Electives (3.50 Credits)

##### Prerequisites

<del>ENGG*2030</del> [0.50] <del>Traditional Energy Sources, W</del> Replacement course ENGG*3080, F	<del>CHEM*1040, ENGG*2120</del>
<del>ENGG*2050</del> [0.75] <del>Emerging Energy Systems, W</del> Replacement course ENGG*4230, F	<del>ENGG*2030, PHYS*1010</del>
<del>ENGG*3030</del> [0.50] <del>Energy Distribution, F</del> Replacement course ENGG*3250, W	<del>ENGG*2030, ENGG*2450, ENGG*3240, ENGG*3410</del>
ENGG*3070 [0.50] Integrated Manufacturing Systems, F	ENGG*2120, ENGG*2450, Co-requisite: ENGG*3410 (Co-req will be removed in future, see Program Counsellor if required)
ENGG*3080 [0.50] Energy Resources and Technologies, F	None; Co-requisite ENGG*3260; Restriction ENGG*2030
ENGG*3120 [0.75] Computer Aided Design and Manufacturing, W	ENGG*2100, ENGG*3280
ENGG*3150 [0.50] Engineering Biomechanics, W	ENGG*2160
ENGG*3170 [0.50] Biomaterials, F	ENGG*2120
ENGG*3250 [0.50] Energy Management and Utilization, W	None; Co-requisite ENGG*3430; Restriction ENGG*3030
ENGG*3390 [0.50] Signal Processing, F	ENGG*2400
ENGG*3490 [0.75] Introduction to Mechatronic Systems Design, W	ENGG*3450, Co-requisite: ENGG*3410
ENGG*3640 [0.50] Microcomputer Interfacing, F	ENGG*2410, ENGG*2450
ENGG*3700 [0.50] Optimization for Engineers, F	CIS*1500, MATH*2130, MATH*2270
ENGG*4050 [0.50] Quality Control, W	STAT*2120
ENGG*4230 [0.75] Energy Conversion, F	ENGG*3080, ENGG*3260; Restriction ENGG*2050
ENGG*4280 [0.75] Digital Process Control Design, W	ENGG*3410
ENGG*4430 [0.50] Neuro-Fuzzy and Soft Computing Systems, W	ENGG*3410; Co-requisite ENGG*4280
ENGG*4440 [0.50] Computational Fluid Dynamics, W	ENGG*2230, ENGG*3370
ENGG*4460 [0.50] Robotic Systems, F	ENGG*1500, ENGG*2400
ENGG*4470 [0.50] Finite Element Analysis, F	ENGG*2340, MATH*2130, MATH*2270
ENGG*4510 [0.50] Assessment and Management of Risk, W	STAT*2040 or STAT*2120
ENGG*4660 [0.50] Medical Image Processing, W	ENGG*3390

##### List MECH-2:

##### Mechanical Engineering Design Electives (0.75 Credits)

ENGG*4030 [0.75] Manufacturing Systems Design, W	ENGG*3070, ENGG*3120, ENGG*3510, ENGG*4460 Co-requisites: ENGG*4050, ENGG*4280
ENGG*4220 [0.75] Interdisciplinary Mechanical Engineering Design, W	ENGG*3100
ENGG*4580 [0.75] Sustainable Energy Systems Design, W	ENGG*3370, ENGG*3430, ENGG*4230
ENGG*4400 [0.75] Biomechanical Engineering Design, F	ENGG*3150, ENGG*3170
ENGG*4480 [0.75] Advanced Mechatronic System Design, W	ENGG*3490, ENGG*3640, ENGG*4460

## Engineering Program Guide (Fall 2012- Winter 2013)

Mechanical Engineering [Regular and Coop]

MECH/MECH:C

Schedule of Studies

### *Conditions for Graduation*

To qualify for the degree, the student must complete the courses required for the Bachelor of Engineering Program in Mechanical Engineering, 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.

**End of mechanical engineering program requirements for students following the 2012/13 Undergraduate Course Calendar.**

## Engineering Program Guide (Fall 2012- Winter 2013)

### Water Resources Engineering [Regular and Coop]

WRE/WRE:C

#### Schedule of Studies

##### Semester 1 (Fall) 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

##### Prerequisites

4U Chemistry (or equivalent) or CHEM*1060
None
None
1 of 4U Calculus and Vectors, 4U Advanced Functions and Calculus

One of:

ENGG*1210	[0.50] Engineering Mechanics I	None
HIST*1250	[0.50] Science and Technology in a Global Context	None

##### Semester 2 (Winter) 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

##### Prerequisites

CHEM*1040
MATH*1200
1 of MATH*1000, MATH*1080, MATH*1200
(MATH*1080 or MATH*1200), [1 of 4U Physics, (or equivalent), PHYS*1020]

One of:

ENGG*1210	[0.50] Engineering Mechanics I	None
HIST*1250	[0.50] Science and Technology in a Global Context	None

##### Semester 3 (Fall) Regular or Co-op

COOP*1100	[0.00] Intro to Co-operative Education
ENGG*2400	[0.50] Engineering Systems Analysis

##### Prerequisites

Co-op students only as requirement for entry into the first work term
ENGG*1210, ENGG*1500, MATH*1200, MATH*1210, PHYS*1130
Co-requisite MATH*2270
1 of GEOG*1300, GEOG*1350, GEOL*1050, GEOL*1100
ENGG*1500, MATH*1210

GEOG\*2000 [0.50] Geomorphology [1]

MATH\*2270 [0.50] Applied Differential Equations

One of:

BIOL*1090	[0.50] Introduction to Molecular and Cellular Biology	4U Biology (or Grade 12 Biology) recommended
MICR*2420	[0.50] Introduction to Microbiology	4.00 credits including one of BIOL*1070, BIOL*1080, BIOL*1090, CHEM*1040

One of:

ENGG*2100	[0.75] Engineering and Design II	Completion of 4.0 credits including ENGG*1100
STAT*2120	[0.50] Probability and Statistics for Engineers	1 of IPS*1510, MATH*1210, MATH*2080

One of:

ENGG*2120	[0.50] Material Science	CHEM*1040, PHYS*1130
ENGG*2230	[0.50] Fluid Mechanics	ENGG*1210, MATH*1210

[1] Water Resources Engineering (WRE) students are permitted to take GEOG\*2000 without completing the prerequisite. However, Webadvisor will not allow you to register for GEOG\*2000 if you have not completed the prerequisite. A prerequisite waiver form may be obtained from the Student Client Services on the 3<sup>rd</sup> floor of the UC and must be signed by either the course instructor or the engineering program counsellor, when designated.

##### Semester 4 (Winter) 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

##### Prerequisites

ENGG*2400, (PHYS*1010 or PHYS*1130)
(CHEM*1040 or CHEM*1310), GEOG*2000
CHEM*1050, MATH*2270
1 of IPS*1510, MATH*1210, MATH*2080

One of:

ENGG*2100	[0.75] Engineering and Design II	Completion of 4.0 credits including ENGG*1100
STAT*2120	[0.50] Probability and Statistics for Engineers	1 of IPS*1510, MATH*1210, MATH*2080

One of:

ENGG*2120	[0.50] Material Science	CHEM*1040, PHYS*1130
ENGG*2230	[0.50] Fluid Mechanics	ENGG*1210, MATH*1210

Schedule of Studies continued on next page...

# Engineering Program Guide (Fall 2012- Winter 2013)

## Water Resources Engineering [Regular and Coop]

WRE/WRE:C

### Schedule of Studies

#### Semester 5 (Fall) 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  
ELECTIVE [0.50] Restricted Elective

#### Semester 6 (Winter) Regular or Semester 7 (Winter) Co-op

ENGG\*3100 [0.75] Engineering and Design III

ENGG\*3430 [0.50] Heat and Mass Transfer  
ENVS\*3060 [0.50] Groundwater  
ELECTIVE [1.50] Restricted Electives [4]

#### Semester 7 (Fall) Regular or Semester 6 (Fall) 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  
ELECTIVE [1.00] Restricted Elective

#### Semester 8 (Winter) Regular or Co-op

ENGG\*4150 [1.00] Water Resources Engineering Design IV

ENGG\*4250 [0.75] Watershed Systems Design [4]  
ELECTIVE [1.00] Restricted Electives

#### Prerequisites

MATH\*1210  
CHEM\*1040, ENGG\*2230, ENGG\*2400, MATH\*2270  
ENGG\*2230, ENGG\*2560, (1 of BIOL\*1040, BIOL\*1090 or  
MICR\*2420), STAT\*2120  
(ENGG\*2230 or MET\*2030), (MATH\*1210 or MATH\*2080),  
(STAT\*2120 or STAT\*2040) and competency in computing  
ENGG\*2120, ENGG\*2230

See elective lists

#### Prerequisites

Registration in the B.Eng. program and completion of 6.00 credits of  
ENGG courses including ENGG\*2100

**Students must have a minimum cumulative average of 60% in all  
ENGG courses for entry into ENGG\*3100. Restriction waiver  
requests are handled by the Director, School of Engineering, or  
designate.**

ENGG\*2230, ENGG\*3260, MATH\*2270  
1 of IPS\*1110, MATH\*1000, MATH\*1080, MATH\*1200

See elective lists

#### Prerequisites

(CIS\*1500 or CIS\*1600), (1 of MATH\*1000, MATH\*1080, MATH\*1200)

ENGG\*2230, ENGG\*3650, ENGG\*3670  
ENGG\*2230, ENGG\*3650

See elective lists

#### Prerequisites

All 1000 and 2000 level core credits plus ENGG\*3100. Must be  
enrolled in the B.Eng. Program. This course must be taken in the final  
semester with a maximum of 3.25 credits. Admission to the course is  
by instructor's permission in the semester prior to the course offering.

**Students must have a minimum cumulative average of 60% in all  
ENGG courses for entry into ENGG\*4150. Restriction waiver  
requests are handled by the Director, School of Engineering, or  
designate.**

ENGG\*2230, ENGG\*3650

See elective lists

[4] ENGG\*4250 can also be taken in Semester 6 Regular or Semester 7 Co-op if students prefer to take electives in Semester 8.

### Water Resources Engineering Electives

Water resources engineering students must complete the following restricted electives. You can take these courses where Restricted Electives are indicated in the Schedule of Studies above.

**A maximum of 1.5 credits at the 1000 course level is allowed for elective requirements.**

- [1.00] credits in Water Resources Engineering Electives in **List WRE-1**
- [0.50] credits in Environmental Resources Elective in **List WRE-2**
- [0.50] credits in Water Resources Elective in **List WRE-3**
- [2.00] credits in Complementary Studies Electives in Lists **CS-1, CS-2 and CS-3**  
(Complementary Studies elective list is located at the back of this program guide)

## Engineering Program Guide (Fall 2012- Winter 2013)

### Water Resources Engineering [Regular and Coop]

WRE/WRE:C

#### Schedule of Studies

All elective course offerings are subject to a minimum enrolment of 10 students. Courses may be cancelled by the university at any time if enrolment is less than 10. Semester offerings for courses may change without notice. Students should refer to the current Undergraduate Calendar to confirm that the course will be offered in the semester indicated in the elective lists within this program guide.

#### List WRE-1:

##### Water Resources Engineering Electives (1.0 Credit)

ENGG*3410 [0.50]	Systems and Control Theory, W	ENGG*2400, MATH*2270 Co-requisite ENGG*2450
ENGG*3450 [0.50]	Electrical Devices, F	ENGG*2450
ENGG*4260 [0.75]	Water and Wastewater Treatment, W	ENGG*3100, ENGG*3590
ENGG*4340 [0.50]	Solid & Hazardous Waste Management, F	ENGG*2560 or ENGG*2660
ENGG*4510 [0.50]	Assessment & Management of Risk, W	STAT*2040 or STAT*2120

#### List WRE-2:

##### Environmental Resources Electives (0.50 Credits)

BIOL*1020 [0.50]	Introduction to Biology, F	Restrictions: BIOL*1030, BIOL*1040, BIOL*1070, BIOL*1080, BIOL*1090
BIOL*1070 [0.50]	Discovering Biodiversity, F/W	Restrictions: BIOL*1030, BIOL*1040
BIOL*1090 [0.50]	Introduction to Molecular and Cellular Biology, F/W	Restrictions: BIOL*1030, BIOL*1040
BIOL*2060 [0.50]	Ecology, F/W <sup>1</sup>	4.00 credits including BIOL*1040 or BIOL*1070
BIOL*3450 [0.50]	Introduction to Aquatic Environments, F <sup>2</sup>	(BIOL*1040 or BIOL*1070), CHEM*1050, (1 of IBIO*2300, ZOO*2070 or ZOO*2700 is strongly recommended)
CHEM*3360 [0.50]	Environmental Chemistry and Toxicology, S/W	CHEM*1050; Equates: TOX*3360
GEOG*1300 [0.50]	Introduction to the Biophysical Environment, F/W	Restriction: GEOG*1350
GEOG*3210 [0.50]	Management of the Biophysical Environment, F <sup>3</sup>	7.50 credits including (ENVS*2150 or GEOG*2210)
GEOG*4210 [0.50]	Environmental Governance, F	GEOG*3210
MICR*4180 [0.50]	Microbial Processes in Environmental Management, F <sup>4</sup>	BIOC*2580, BIOL*1040

<sup>1</sup> Students wishing to take BIOL\*2060 will require BIOL\*1070 as a prerequisite. One of these two courses will not count toward their degree, but will be included on their transcript as an extra course.

<sup>2</sup> Students wishing to take BIOL\*3450 will require BIOL\*1070 as a prerequisite. One of these two courses will not count toward their degree, but will be included on their transcript as an extra course.

<sup>3</sup> The prerequisite, GEOG\*2210 can be taken as part of the Complementary Studies elective requirement.

<sup>4</sup> Students wishing to take MICR\*4180 will require BIOC\*2580 and BIOL\*1040 as a prerequisite, neither of which will count toward their degree, but will be included on their transcript as an extra course.

## Engineering Program Guide (Fall 2012- Winter 2013)

### Water Resources Engineering [Regular and Coop]

WRE/WRE:C

#### Schedule of Studies

#### List WRE-3:

#### Water Resources Electives (0.50 Credits)

GEOG*2420 [0.50]	The Earth from Space, F	0.50 credit in geography and/or earth science
GEOG*2480 [0.50]	Mapping and GIS, F/W	5.00 credits
GEOG*3000 [0.50]	Fluvial Processes, F	GEOG*2000, (GEOG*2460 or STAT*2040)
GEOG*3420 [0.50]	Remote Sensing of the Environment, W	10.00 credits including GEOG*1300
GEOG*4150 [0.50]	Sedimentary Processes, W	GEOG*3000
ENVS*1060 [0.50]	Principles of Geology, S/F/W	None
ENVS*2030 [0.50]	Meteorology and Climatology, F	None
ENVS*2060 [0.50]	Soil Science, S/F/W	None
ENVS*2160 [0.50]	Glacial Geology no lab, W	1 of AGR*2320, ENVS*1050, ENVS*1060, ENVS*2060, GEOG*1300, GEOL*1050, GEOL*1100, SOIL*2010
OR		
ENVS*2200 [0.50]	Glacial Geology with lab, W	
ENVS*3110 [0.50]	Resource Planning Techniques, W	ENVS*3120 or SOIL*3050
ENVS*3120 [0.50]	Land Utilization, F	1 of AGR*2301/2, AGR*2320, ENVS*2060, GEOG*1300, GEOL*1000, SOIL*2010
ENVS*3130 [0.50]	Lab & Field Methods in Groundwater, F	ENVS*3060 or GEOL*3060
ENVS*3190 [0.50]	Environmental Water Chemistry, F	1 of CHEM*1010, CHEM*1050, CHEM*1310

#### *Conditions for Graduation*

To qualify for the degree, the student must complete the courses required for the Bachelor of Engineering Program in Water Resources Engineering, 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.

**End of water resources engineering program requirements for students following the 2012/13 Undergraduate Course Calendar.**

# Engineering Program Guide (Fall 2012- Winter 2013)

## Complementary Studies Electives

Professional engineers often face complex situations involving sociological, political and economic factors in addition to technical and technological problems. Recognition of the human aspects is so important that special attention should be paid to the humanities, social sciences and to areas of administrative studies. As an engineering student at the University of Guelph, you should strive to become aware of the role of professional engineers in society and the contribution engineering makes to the economic, social and cultural aspirations of society. In completing the complementary studies electives courses, along with ENGG\*3240 Engineering Economics and HIST\*1250 Science & Society Since 1500 in the core curriculum, you should gain an understanding of:

- The nature of the human and natural environment and the impact of technology on it;
- The function and roles of individuals, organizations, business and governments in shaping our society and its values;
- The ethical and legal responsibilities, guidelines and constraints within which the engineering profession functions, and;
- Effective communication within the profession and society at large.

The term “complementary” within the context of CEAB requirements is not intended to mean “directly related to or relevant to your specific technical area of study within engineering”. These electives are meant to broaden your knowledge of society, culture, government, economy, etc. so that you may better understand the impact of engineering on society at large.

Your selection of complementary studies elective courses should be considered with regard to both personal interest and career aspirations so as to ensure that some maturity is attained in the elective area of study. Advice may be obtained from program counsellors or faculty advisors within the departments of the university offering the course or courses of interest.

**B.Eng. students must select [2.00] credits (four courses) from the Complementary Studies electives in the Lists provided below. You must select one course from each of the three sub-lists (CS-1, CS-2, CS-3). The remaining 0.5 credit can be chosen from any of the three sub-lists.**

Students should refer to Course Descriptions in the current Undergraduate Calendar for prerequisites, class hours and the semester(s) in which courses are offered.

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c12/index.shtml>.

The letters S, F, W indicate the University's intention to offer the course in the Summer (S), Fall (F) or Winter (W) semester. The letter U indicates that an intended offering has not been assigned to the course. Students should consult the Undergraduate Course Timetable posted on WebAdvisor <<https://webadvisor.uoguelph.ca/>> or contact the departments offering those courses to determine the semester offerings.

It is the responsibility of each student to contact the relevant department to check the flexibility of the prerequisites and course availability. Prerequisite waivers are at the discretion of the course instructor only.



# Engineering Program Guide (Fall 2012- Winter 2013)

## List CS-1: Central Issues

ASCI*3100	[0.50] Case Studies in Arts and Sciences Research, W
EDRD*4020	[0.50] Rural Extension in Change and Development, F
FARE*1300	[0.50] Food, Poverty and Hunger, W ( <i>Equates: AGECE*1300</i> )
GEOG*1200	[0.50] Society and Space, F/W
GEOG*1220	[0.50] Human Impact on the Environment, F/W
GEOG*2210	[0.50] Environment and Resources, W
GEOG*2510	[0.50] Canada: A Regional Synthesis, W
GEOG*3020	[0.50] Global Environmental Change, F
GEOG*3050	[0.50] Development and the City, W
GEOG*3210	[0.50] Management of the Biophysical Environment, F
POLS*1500	[0.50] World Politics, F
POLS*2080	[0.50] Development and Underdevelopment, F
POLS*2200	[0.50] International Relations, F
POLS*2250	[0.50] Public Administration and Governance, W
POLS*2300	[0.50] Canadian Government and Politics, F/W
POLS*3060	[0.50] Politics of the Middle East and North Africa, U
POLS*3080	[0.50] Politics of Latin America, U
POLS*3250	[0.50] Public Policy: Challenges and Prospects, F
POLS*3270	[0.50] Local Government in Ontario, U

## List CS-2: Methodologies

ACCT*2220	[0.50] Financial Accounting, F/W ( <i>Equates: BUS*2220</i> )
ACCT*2230	[0.50] Management Accounting, F/W ( <i>Equates: BUS*2230</i> )
ECON*1050	[0.50] Introductory Microeconomics, S/F/W
ECON*1100	[0.50] Introductory Macroeconomics, S/F/W
ECON*2000	[0.50] Economic Problems in Canada, U
ECON*2100	[0.50] Economic Growth and Environmental Quality, F
ECON*2200	[0.50] Industrial Relations, F
ECON*2310	[0.50] Intermediate Microeconomics, S/F/W
ECON*2410	[0.50] Intermediate Macroeconomics, S/F/W
EDRD*2650	[0.50] Introduction to Planning and Environmental Law, F/W
EDRD*3000	[0.50] Program Development and Evaluation, W
EDRD*3140	[0.50] Organizational Communication, S
EDRD*3160	[0.50] International Communication, W
EDRD*4120	[0.50] Leadership Development in Small Organizations, F
FARE*2700	[0.50] Survey of Natural Resource Economics, F ( <i>Equates: AGECE*2700</i> )
FARE*4310	[0.50] Resource Economics, W ( <i>Equates: AGECE*4310</i> )
FARE*4360	[0.50] Marketing Research, W ( <i>Equates: AGECE*4360</i> )
MCS*1000	[0.50] Introductory Marketing, S/F/W
MCS*2600	[0.50] Fundamentals of Consumer Behaviour, F/W
MCS*3010	[0.50] Quality Management, W
MCS*3040	[0.50] Business and Consumer Law, S/F/W
MGMT*2150	[0.50] Introduction to Canadian Business Management, U
ENVS*2120	[0.50] Introduction to Environmental Stewardship ( <i>Equates SOIL*2120, NRS*2120</i> ), F
POLS*1400	[0.50] Issues in Canadian Politics, F
POLS*3370	[0.50] Environmental Politics and Governance, S/F

List CS-3 continued on next page...

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### List CS-3: Social Sciences

ANTH*1150	[0.50] Introduction to Anthropology, F/W
ANTH*2160	[0.50] Social Anthropology, W
ANTH*3400	[0.50] The Anthropology of Gender, W
ARTH*XXXX	All Art History courses
ECON*3720	[0.50] History of the World Economy Since 1850, U
ECON*3730	[0.50] Europe and the World Economy to 1914, U
ENGL*1200	[0.50] Reading the Contemporary World, F/W
ENGL*1410	[0.50] Major Writers, U
ENGL*2200	[0.50] Postcolonial Literatures, F
ENVS*3280	[0.50] Environmental Perspectives and Human Choices II, W
FARE*4310	[0.50] Resource Economics, W ( <i>Equates: AGEC*4310</i> )
FREN*2020	[0.50] France: Literature and Society, F/W
FREN*2060	[0.50] Québec: Literature and Society, F/W
FRHD*1010	[0.50] Human Development, W
HIST*XXXX	All History courses
ISS*3420	[0.50] Women Social and Political Theorists, W
NUTR*1010	[0.50] Nutrition and Society, F/W
PHIL*1000	[0.50] Introductory Philosophy: Major Texts, F/W
PHIL*1010	[0.50] Introductory Philosophy: Social and Political Issues, F/W
PHIL*1050	[0.50] Introductory Philosophy: Basic Problems, F/W
PHIL*2030	[0.50] Philosophy of Medicine, F/W
PHIL*2060	[0.50] Philosophy of Feminism I, W
PHIL*2070	[0.50] Philosophy of the Environment, W
PHIL*2100	[0.50] Critical Thinking, F/W
PHIL*2120	[0.50] Ethics, F/W
PHIL*2130	[0.50] Philosophy of Religion, F
PHIL*2180	[0.50] Philosophy of Science, F
PHIL*2600	[0.50] Business and Professional Ethics, W
PHIL*3230	[0.50] Issues in Social and Political Philosophy, W
PSYC*1000	[0.50] Introduction to Psychology, S/F/W
PSYC*1010	[0.50] Quantification in Psychology, F/W
PSYC*2310	[0.50] Intro to Social Psychology, S/F/W
PSYC*2330	[0.50] Principles of Learning, F/W
SOC*1100	[0.50] Sociology, S/F/W
SOC*1500	[0.50] Crime and Criminal Justice, F/W
SOC*2010	[0.50] Canadian Society, U
SOC*2070	[0.50] Social Deviance, S/F/W
SOC*2080	[0.50] Rural Sociology, W
SOC*2280	[0.50] Society and Environment, U
SOC*3380	[0.50] Society and Nature, U
SOC*3410	[0.50] Individual and Society, U
WMST*XXXX	All Women's Studies courses

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## Engineering Minors

You must be registered in the B.Eng. program to add either of the Engineering Minors. Declaration of these Minors must be done prior to entering Semester 6 [Regular] or Semester 7 [Coop] because ENGG\*3100 and your final design project (ENGG\*41X) will require the application of both your Major and Minor programs. In addition, you must notify the course instructor of ENGG\*3100 and your final design (41X) advisor that you are enrolled in an Engineering Minor within the first week of classes.

**Courses that you take for the Minors will be counted towards the appropriate elective areas in your Major program.**

### Environmental Engineering Minor

<b>The Minor may be obtained by taking additional courses:</b>		<b>Prerequisites</b>
BIOC*2580	[0.50] Introduction to Biochemistry	CHEM*1050 or CHEM*2300
CHEM*3360	[0.50] Environmental Chemistry and Toxicology	CHEM*1050; Equates: TOX*3360
ENGG*3180	[0.50] Air Quality	ENGG*2230, (ENGG*2560 or ENGG*2660), Co-requisite ENGG*3260
ENGG*3590	[0.50] Water Quality	ENGG*2230, ENGG*2560, (1 of BIOL*1040, BIOL*1090, MICR*1020 or MICR*2420), STAT*2120
ENGG*4260	[0.75] Water and Wastewater Treatment Design	ENGG*3100, ENGG*3590
GEOG*1300	[0.50] Intro to the Biophysical Environment	None
MICR*2420	[0.50] Introduction to Microbiology	4.00 credits including 1 of BIOL*1040, BIOL*1070, BIOL*1080, BIOL*1090 or CHEM*1040
MICR*4180	[0.50] Microbial Processes in Environmental Management	BIOC*2580, [BIOL*1040 or (2 of BIOL*1070, BIOL*1080, BIOL*1090)]
One of:		
ENGG*2560	[0.50] Environmental Engineering Systems	CHEM*1050, MATH*2270
ENGG*2660	[0.50] Biological Engineering Systems	ENGG*2400, MATH*2270, (1 of BIOL*1030, BIOL*1070, BIOL*1080, BIOL*1090 or MICR*1020)
One of:		
ENGG*3470	[0.50] Mass Transfer Operations	ENGG*2230, ENGG*3260, MATH*2270, Co-requisite ENGG*3430
ENGG*4330	[0.75] Air Pollution Control	ENGG*3180, ENGG*3260
ENGG*4340	[0.50] Solid & Hazardous Waste Management	ENGG*2560 or ENGG*2660

**You must select an environmental application for your final design project in your major program.**

### Food Engineering Minor

<b>The Minor may be obtained by taking additional courses:</b>		<b>Prerequisites</b>
BIOC*2580	[0.50] Introduction to Biochemistry	CHEM*1050 or CHEM*2300
ACCT*2220	[0.50] Financial Accounting	1 of ECON*1050, ECON*1100, ENGG*3240
ENGG*2660	[0.50] Biological Engineering Systems I	ENGG*2400, MATH*2270, (1 of BIOL*1030, BIOL*1070, BIOL*1080, BIOL*1090 or MICR*1020)
ENGG*3830	[0.50] Bio-Process Engineering	ENGG*2230, ENGG*2660, Co-requisite ENGG*3260
FOOD*2150	[0.50] Intro to Nutritional and Food Sciences	(BIOL*1040 or BIOL*1080), (CHEM*1040 or CHEM*1300); Equates: NUTR*2150
MICR*2420	[0.50] Introduction to Microbiology	4.00 credits including 1 of BIOL*1040, BIOL*1070, BIOL*1080, BIOL*1090 or CHEM*1040
One Of:		
ENGG*4300	[0.75] Food Processing Engineering Design	ENGG*3260, ENGG*3830
ENGG*4380	[0.75] Bio Reactor Design	ENGG*3160
Two of:		
FOOD*4070	[0.50] Food Packaging	8.00 credits in science or engineering
FOOD*4110	[0.50] Meat and Poultry Processing	1 of ANSC*2340, FOOD*3090, FOOD*3160
MCS*3010	[0.50] Quality Management	9.00 credits including [0.50] credits in statistics; Equates: COST*3010
One of:		
FOOD*3160	[0.75] Food Processing I	[FOOD*2620, (MICR*2420 or MICR*2030)] or ENGG*2660
FOOD*4520	[0.50] Utilization of Cereal Grains for Human Food	BIOC*2580, (1 of BIOL*1040, BIOL*1070, BIOL*1080)
One of:		
FOOD*2400	[0.50] Introduction to Food Chemistry	CHEM*1040
FOOD*3030	[0.50] Food Chemistry I	BIOC*2580
FOOD*3230	[0.75] Food Microbiology	1 of MICR*1020, MICR*2030, MICR*2420
FOOD*3260	[0.50] Industrial Microbiology	1 of MICR*1020, MICR*2020, MICR*2030, MICR*2420

**You must select a food application project for your final design project in your major program.**