



MEMORANDUM

To: Executive Committee of Faculty Council

From: Professor Chris Damaren
Chair, Engineering Graduate Education Committee

Date: October 19, 2012 for November 29, 2012 Faculty Council Meeting

Re: **Proposal for a Combined BSc (Environmental Science, UTSC) / MEng (FASE) Program**

REPORT CLASSIFICATION

This is a major policy matter that will be considered by the Executive Committee for endorsing and forwarding to Faculty Council for vote as a regular motion (requiring a simple majority of members voting to carry).

BACKGROUND

Both the University of Toronto Scarborough (UTSC) and the Faculty of Applied Science and Engineering (FASE) wish to grow in the environmental field, a burgeoning academic focus for both intellectual pursuit and occupational demand – and are consequently proposing to combine two excellent existing programs to the benefit of both units.

The combination of the four undergraduate Specialist programs in Environmental Science (Environmental Biology, Environmental Chemistry, Environmental Geoscience, and Environmental Physics) at UTSC, and the graduate Master of Engineering (MEng) program (in Chemical Engineering & Applied Chemistry, or Civil Engineering) at FASE will produce a well-educated and trained environmental professional able to meet the developing environmental needs of our society.

STRUCTURE

The combined program will be five years in duration. In years 1-3, students will work on their BSc requirements. In Year 4, they will work on their BSc requirements (including two FASE undergraduate half courses and up to 1.0 FCE of MEng requirements). The 1.0 FCE of MEng requirements (two half courses) can be counted towards the BSc and MEng requirements. In Year 5, students will fulfill the remaining MEng requirements.

PROPOSAL/MOTION

“THAT the combined BSc-UTSC/MEng program, as outlined in the attached proposal, be established.”

University of Toronto Major Modification Proposal – Type C: Combined Program

Section 1

Program Proposed:	<p>Combined Bachelor of Science (Environmental Science) UTSC/Master of Engineering (Chemical Engineering & Applied Chemistry and Civil Engineering)</p> <p>Short form: Combined BSc-UTSC/MEng Program</p>
Department(s) / Graduate Unit(s)involved:	<p>University of Toronto Scarborough Department of Physical and Environmental Sciences with Faculty of Applied Science and Engineering Departments of Chemical Engineering & Applied Chemistry, and Civil Engineering</p>
Faculty(s) / Academic Division(s):	<p>University of Toronto Scarborough (UTSC); Faculty of Applied Science and Engineering (FASE)</p>
Faculty / Academic Division Contact:	<p>Annette Knott Academic Programs Officer aknott@utsc.utoronto.ca</p>
Department / Unit Contact:	<p>William Gough (UTSC) Chris Damaren (FASE)</p>
Anticipated start date of new program:	<p>September 1, 2013</p>
Version Date:	<p>October 19, 2012</p>

Section 2

1. Executive Summary

The Environmental Science Specialist and Major programs (including a Co-op option), offered through the Department of Physical and Environmental Sciences at the University of Toronto Scarborough (UTSC), have experienced steady growth over the past 20 years. In that time, the Specialist program has evolved into four separate programs (Environmental Biology, Environmental Chemistry, Environmental Geoscience, and Environmental Physics) to which a Minor program in Environmental Science has been added. Recently, the Specialist and Major undergraduate programs were accredited by the Environmental Careers Organization (ECO). In addition, at the graduate level, a highly successful professional Master's program was launched in 2006 (<http://www.utsc.utoronto.ca/~physsci/menvsci/>), followed by an equally successful Ph.D. in 2010 (<http://www.utsc.utoronto.ca/~physsci/phd/>).

As part of its efforts to actively seek out new ways to expand its offerings, and deepen the educational experience of its students, UTSC has been in discussions with the Faculty of Applied Science and Engineering (FASE) to explore possible areas of collaboration. Environmental Science has been identified as one such area, as many graduates of the UTSC Environmental Science programs have expressed an interest in the expertise that an Engineering program can provide. This is especially true for those desiring to work in the environmental consulting industry.

UTSC and FASE are in agreement that a combined program between the UTSC Environmental Science Specialist programs (B.Sc.) (http://www.utsc.utoronto.ca/~physsci/environ_sci) and the Master of Engineering (M.Eng.) offered by FASE (http://www.engineering.utoronto.ca/Future_Students/Graduate_Studies/gradprograms/Master_of_Engineering.htm) is an ideal area for collaboration, and are consequently proposing a Combined program that allows students to complete a Bachelor of Science (B.Sc.) in any one of the four undergraduate Specialist programs in Environmental Science identified above, and a Master of Engineering (M.Eng) in two programs, Chemical Engineering & Applied Chemistry, and Civil Engineering,. The appeal of this combined program is twofold: it allows students to apply early to the Master of Engineering program (in the third year of the B.Sc.), and it allows them to complete the Combined program in less time than is normally the case for an M.Eng. that follows upon a bachelor's degree. It should be noted that completion of the proposed Combined program will not provide a path to licensure as a professional engineer (this requires completion of an accredited undergraduate degree in engineering).

The FASE programs are professional Master's programs (M.Eng.). The combination of the M.Eng. with the B.Sc. in Environmental Science is ideal for students looking to work in the environmental consulting industry. It also provides a rich intellectual pathway for exceptional undergraduate students by providing access to graduate courses and a graduate milieu before the completion of an undergraduate degree. Students participating in the Combined program will have the option of pursuing the M.Eng. program in either the Department of Chemical Engineering & Applied Chemistry, or Civil Engineering.

Providing the option of a Combined undergraduate Environmental Science/graduate Engineering program will enhance the attractiveness of UTSC's Specialist undergraduate programs in Environmental Science thus yielding more and better applicants, both domestic and international. At present UTSC enrolls just under 100 Environmental Science Specialist students and has the capacity to double this number. The combined program will provide an excellent stream of students with a well-defined environmental educational background to the M.Eng. program. This will enhance the environmental offerings at the University of Toronto by providing an academic pathway for very strong students.

The increase in the number of M.Eng. students is consistent with FASE's desire to expand M.Eng. enrolments with excellent students. Environmental studies are an important element of the graduate programs in Chemical Engineering & Applied Chemistry and Civil Engineering, and the academic environment will be improved by the diverse backgrounds that the B.Sc. students bring to the classroom.

The B.Sc. in Environmental Science includes fundamental courses in science and mathematics. This will be bolstered by the requirement that participants complete two undergraduate engineering courses as part of their B.Sc. degree requirements. This will ensure that participants have the proper background for completing the M.Eng. program.

Students will apply to the combined program during the Fall term of the third year of the B.Sc. program. Offers of admission will be conditional on maintaining at least a B+ average in the third and fourth years of study, as well as conditional on completing the B.Sc. program and having the degree conferred. During the conditional admission period students will be required to take two undergraduate engineering courses which can be used to meet the degree requirements of the B.Sc. These courses will be identified by the relevant FASE department (either Chemical Engineering & Applied Chemistry, or Civil Engineering). Students in the Combined program who have accepted conditional offers of admission to the M.Eng. program will also be eligible to take two half courses from the Master's courses that will count towards both degrees. Students will be graded as undergraduate students in those graduate courses according to the requirements of the University Assessment and Grading Practices Policy, and will require a grade of B- or better in order for the course to count for graduate credit towards the master's program.

2. Program Rationale

Both the University of Toronto Scarborough (UTSC) and the Faculty of Applied Science and Engineering (FASE) wish to grow in the environmental field - a burgeoning academic focus for both intellectual pursuit and occupational demand – and are consequently proposing to combine two excellent existing programs to the benefit of both units.

The combination of the four undergraduate Specialist programs in Environmental Science (Environmental Biology, Environmental Chemistry, Environmental Geoscience, and Environmental Physics) at UTSC, and the graduate Master of Engineering (M.Eng.) program at FASE will produce a well-educated and trained environmental professional able to meet the

developing environmental needs of our society. The Combined program will be five years in length (4+1).

Providing this Combined program will enhance the attractiveness of the UTSC undergraduate programs in Environmental Science thus yielding more and better undergraduate applicants, both domestic and international. It will also provide an excellent stream of students with a well-defined environmental educational background to the M.Eng. program.

The UTSC undergraduate program will gain by having a well-defined pathway into the exceptionally well-regarded Engineering programs offered by FASE. In turn FASE will have a novel stream of students well prepared in the foundations of environmental science, and in the cutting edge issues of this emerging discipline. They will bring a perspective to their courses that is different from their engineering counterparts.

The Specialist undergraduate programs in Environmental Science currently enrol almost 100 students and there is capacity for this to grow by 50 – 100%. The new combined program is consistent with FASE's desire to increase M.Eng. eligible full-time equivalents (EFTEs) by 15% (approximately 50 students) by 2015.

Other universities do offer combined programs, particularly Faculties of Engineering (e.g. Waterloo), however we understand this particular combination of Environmental Science and Engineering to be unique in Canada.

3. Need and Demand

The UTSC Department of Physical and Environmental Science has discussed this proposal with the current undergraduates in the Environmental Science Specialist programs and keen interest was expressed. Co-op employers involved with the UTSC programs have also expressed an interest in graduates with these dual credentials. It is anticipated that a steady stream of 5 to 10 students per year will avail themselves of this opportunity. UTSC recruiters comment frequently on the cache of "Engineering" in their visits to high schools. This is also true for the Green Path (a UTSC international recruit program) recruiters. Linking one of the UTSC undergraduate programs to an Engineering program will increase enrolment in undergraduate environmental science programs. These are excellent programs (ECO accredited) and UTSC has the capacity to add more high quality students to the program.

The combination of the undergraduate program in Environmental Science and the graduate program in Engineering will produce a well-educated and trained environmental professional who will meet the developing environmental needs of our society. Graduates of the combined program will possess a combination of pure and applied science that gives them a unique perspective on environmental issues.

Table 1: Enrolment Projections

<i>Year in program</i>	<i>Academic year #1</i>	<i>Academic year #2</i>	<i>Academic year #3</i>	<i>Academic year #4</i>	<i>Academic year#5</i>
	2013/14	2014-15	2015-16	2016-17	2017-18
			10	10	10
<i>Total:</i>			10	10	10

The table shows applications to the M.Eng. component of the combined program; registration & enrolment in the master’s program would commence in year #5.

4. Program Description

The current requirements of both programs will be met by the students in the Combined program.

Two prescribed undergraduate half courses (1.0 FCE) offered by FASE must be counted to the degree requirements (but not program requirements) of the B.Sc. Up to two graduate courses (1.0 FCE) offered by FASE of the 5.0 FCEs required for the M.Eng. may be completed during the student’s fourth year and will count towards both degrees; students must receive a grade of B- or better in order to have the graduate courses count towards the master’s program. For the B.Sc., a total of 20 FCEs are required. The 1.0 graduate FCE will not count towards the 14.5-15.5 (program dependent) FCEs for the program but may be counted towards the remaining 4.5-5.5 FCEs required for the degree.

The normal time for completion will be five years (4+1).

MEng Advanced Start Option

Eligible students may begin the master’s program in the summer immediately following completion of fourth year of the Bachelor’s program. In exceptional circumstances, they would be able to complete the M.Eng. degree requirements by the end of the following December. If they complete the degree requirements by the end of April of the following year, they would be charged fees for a single academic year.

5. Admission Requirements

The admission requirements for the Environmental Science B.Sc. remain identical to the existing programs. [See UTSC Calendar: http://www.utsc.utoronto.ca/~registrar/calendars/calendar/Environmental_Science.html].

Students will apply in year three for admission into the Master of Engineering program. Students must meet the admission requirements for the Master of Engineering program and must have an average of B+ in the last two years of undergraduate study. This exceeds the SGS minimum of a mid-B. Students will be required to maintain at least a B+ average in year three and year four to remain in the Combined program. After admission, students will be eligible to take up to two

half courses in the Master's curriculum while in the B.Sc. program (during year four). These courses can be counted to fulfill degree requirements for the B.Sc. and to fulfill degree and program requirements for the Master's degree providing that grades of B- or better are achieved in each of the graduate courses.

6. Program Requirements

Program Description

The Combined program in Environmental Science (B.Sc.) and M.Eng. allows exceptional students (registered in one of the 4 specialist programs in Environmental Biology, Environmental Chemistry, Environmental Geoscience, or Environmental Physics) to apply for and be considered for admission to the M.Eng. program in Chemical Engineering & Applied Chemistry or Civil Engineering. Students who receive conditional offers of admission during year three of the Bachelor's program and complete the bachelor's program requirements in year four, will commence the M.Eng. during year five. Students who receive conditional offers of admission to the M.Eng. program are considered to be in the Combined BSc-UTSC/M.Eng. Program path.

Combined program students must complete two prescribed engineering half courses (1.0 FCE) as part of the B.Sc. degree requirements. For combined program students, up to 1.0 FCE of the required Master's courses can be taken during year four and count toward the B.Sc. degree requirements and the Master's program and degree requirements, assuming acceptable grades. This permits students to complete the two programs in one session (term) less than would normally be required in the M.Eng. program. Eligible students may begin the master's program in the summer immediately following completion of fourth year of the Bachelor's program.

Minimum Admission Requirements

A call for applications for the Combined program will occur in September of the third year of full-time study in the B.Sc. program. A Combined program admission committee with representation from both UTSC and FASE will vet the applications and recommend offers of admission, recognizing that the Departments of Chemical Engineering and Applied Chemistry, and Civil Engineering have the authority to issue offers of admission to the M.Eng. program. To be eligible for admission into the M.Eng. and the Combined program, students have to be enrolled, and in good standing, in one of the Specialist Programs in Environmental Science (Environmental Biology, Environmental Chemistry, Environmental Geoscience, or Environmental Physics) with a B+ average or higher in year two. Expedited admission into the M. Eng. program is conditional upon students maintaining at least a B+ average in year three and year four. Both of these grade requirements provide a way of identifying exceptionally well-qualified candidates for the combined program.

Program Requirements

Year 1 – B.Sc. requirements

Year 2 – B.Sc. requirements

Year 3 – B.Sc. requirements

Year 4 – B.Sc. requirements (including two FASE undergraduate half courses and up to 1.0 FCE of M.Eng. requirements)

Year 5 – M.Eng. remaining requirements

Within this combined 5-year program, students must:

- Meet the full academic requirements of both programs (B.Sc./M.Eng.)
- Remain enrolled as full-time students during year 3 and after.
- Achieve a B+ average in years 3 and 4 of the B.Sc. program.

The Master of Engineering requires ten half courses. Typically eight courses are taken in the September to April academic sessions (terms) and two remaining courses are taken in the summer session. Thus, the Master’s program can be completed in one year, although some students take up to an additional 2 sessions. In the proposed Combined program, completion of 1.0 FCE in the fourth year of the B.Sc. will permit completion of the M.Eng. in two sessions (terms). Eligible students may begin the master’s program in the summer immediately following completion of fourth year of the Bachelor’s program.

Normal Program Length: **Five years (4 + 1)**

Time Limit: The time limit for the M.Eng. degree will be three years.

7. Consultation

See attached MOU.

The proposal has been developed with consultation with the Dean’s Offices of UTSC and FASE and the departments involved.

8. Resources:

All courses will be offered as currently with no additional teaching resources required. At UTSC a faculty member will oversee the administration of the combined program. This will include publicizing the program, especially among 2nd year students and vetting applications with an FASE representative to ensure students meet the M.Eng./SGS standards. No additional space is required for this combined program. No additional learning resources are required. No financial support is required as there is no student support provided in both programs. No additional infrastructure is required.

9. Governance Process:

	<i>Levels of Approval Required</i>
<i>Consultation with the Provost’s Office</i>	
<i>Decanal Sign Off</i>	
<i>Graduate Curriculum Group Approval</i>	
<i>UTSC Academic Committee Approval</i>	
<i>FASE EGEC Approval</i>	

<i>FASE Faculty Council</i>	
<i>Submission to Provost's Office</i>	
<i>Report to AP&P</i>	
<i>Report to Ontario Quality Council</i>	

Developed by the Office of the Vice-Provost, Academic Programs: April 4, 2011

Chemical Engineering and Applied Chemistry

Faculty Affiliation

Applied Science and Engineering

Degree Programs Offered

Chemical Engineering and Applied Chemistry – MAsc, MEng, BSc/MEng, PhD

Collaborative Programs

The following collaborative programs are available to students in participating degree programs as listed below:

1. **Biomedical Engineering**

Chemical Engineering and Applied Chemistry, MAsc, PhD

2. **Dynamics of Global Change**

Chemical Engineering and Applied Chemistry, PhD

3. **Environmental Engineering**

Chemical Engineering and Applied Chemistry, MAsc, MEng, PhD

4. **Environmental Studies**

Chemical Engineering and Applied Chemistry, MAsc, MEng, PhD

5. **Genome Biology and Bioinformatics**

Chemical Engineering and Applied Chemistry, PhD

6. **Global Health**

Chemical Engineering and Applied Chemistry, PhD

Overview

The Department of Chemical Engineering and Applied Chemistry offers graduate research in pure science, engineering fundamentals, and engineering applications. Graduate programs lead to the degrees of **Master of Applied Science (MAsc)**, **Master of Engineering (MEng)**, and **Doctor of Philosophy (PhD)**. The MEng program differs from the MAsc and PhD programs in that it is oriented to learning through prescribed courses rather than through research.

The department attracts a dynamic professorial staff with outstanding international reputations. Many graduate students work closely with industrial partners during their studies. Research is funded by the government and industry, often by means of a consortium of companies. The experience of dealing with real world problems prepares graduates for successful professional careers.

Research and teaching are the foundations of the department. Research is clustered into eight major categories:

1. Biomolecular and Biomedical Engineering
2. Bioprocess Engineering
3. Chemical and Materials Process Engineering
4. Engineering Informatics
5. Environmental Science and Engineering
6. Pulp and Paper
7. Surface and Interface Engineering
8. Sustainable Energy

A more complete and up-to-date description of graduate programs and enrolment procedures appears on www.chem-eng.utoronto.ca.

In addition, the Department of Chemical Engineering and Applied Chemistry offers the Combined Bachelor of Science (BSc)/Master of Engineering (MEng) degree program. This five-year program was established by the University of Toronto Scarborough (UTSC) and the Faculty of Applied Science and Engineering (FASE) for students who wish to combine graduate training in chemical engineering and applied chemistry with a bachelor's degree in environmental science.

Contact and Address

Web: www.chem-eng.utoronto.ca

E-mail:

Admissions: admissgrad.chemeng@utoronto.ca

General: gradassist.chemeng@utoronto.ca

Telephone: (416) 946-3987

Fax: (416) 978-8605

Department of Chemical Engineering and Applied Chemistry
University of Toronto
Room 212, Wallberg Building
200 College Street
Toronto, Ontario M5S 3E5
Canada

Degree Programs

Chemical Engineering and Applied Chemistry

Master of Applied Science

Minimum Admission Requirements

- Applicants are admitted under the General Regulations of the School of Graduate Studies.

Program Requirements

- Thesis on a research topic.
- At least three graduate half courses (1.5 full-course equivalents [FCEs]), one of which normally must be selected from Category A: Fundamental (see courses below), and at least one of which must be selected in an area outside the student's field of research specialization. Furthermore, only one 500-level course may be taken for credit towards the degree program. Students are also required to complete CHE 2222H and JDE 1000H as well as attend four sessions of the CHE 300xH seminar series. Students are required to take a graduate student seminar, presenting two times during their program, once in the first year and once in the second year of study.
- Each student should discuss possible research projects with several members of the department before selecting a research area and a supervisor.
- The program requires a minimum full-time residence of two sessions (eight months).

Normal Program Length: 6 sessions full-time

Time Limit: 3 years full-time

Master of Engineering

Minimum Admission Requirements

- Applicants are admitted under the General Regulations of the School of Graduate Studies.

Program Requirements

- The program normally requires completion of a total of 5.0 full-course equivalents (FCEs) or 3.5 FCEs plus a 1.5-FCE project supervised by a faculty member. The project must be defended at an oral examination.
- The MEng program can be completed either through full-time or part-time studies. The full-time program is designed to be completed within 12 months, including the summer session. The part-time program is intended primarily for engineers in full-time professional practice.

Normal Program Length: 3 sessions full-time; 9–12 sessions part-time

Time Limit: 3 years full-time; 6 years part-time

Combined Bachelor of Science (Environmental Science)/Master of Engineering

The Combined Program in Environmental Science (BSc) and Master of Engineering (MEng) allows well-qualified students in the BSc Environmental Science Specialist programs (Environmental Biology, Environmental Chemistry, Environmental Geoscience, or Environmental Physics) to apply for and be considered for admission into the MEng program in Chemical Engineering and Applied Chemistry during the 3rd year of their undergraduate study and receive conditional admission to the graduate program then. Students in the combined program will complete it in less time than is normally the case for an MEng that follows upon a bachelor's degree.

Minimum Admission Requirements:

- Each student in the Combined Program shall meet the respective admission requirements of each program.
- To be eligible for admission into the MEng and the Combined Program, students must be enrolled full-time, and in good standing in one of the BSc Specialist programs in Environmental Science (Environmental Biology, Environmental Chemistry, Environmental Geoscience, or Environmental Physics) with a CGPA of 3.3 or higher in Year 2.
- Admission into the MEng program is conditional upon students maintaining at least a CGPA of 3.3 in Years 3 and Year 4 of the BSc.
- Applications will be accepted in the third year of full-time registration in the BSc program.

Program Requirements:

- The full academic program requirements of both programs (BSc/MEng) will be met by students in the Combined Program.
- Students are required to remain registered as full-time students during Year 3 and 4 of the BSc and during the MEng.
- Complete two prescribed undergraduate engineering half courses (1.0 FCE) as part of the BSc degree requirements.
- Complete 10 half courses (5.0 FCEs) required for the Master of Engineering program
- Up to 1.0 FCE of the required master's courses normally are taken during Year 4 and count towards the BSc degree requirements and the MEng degree requirements.
- Students who receive conditional offers of admission during Year 3 of the bachelor's program and complete the bachelor's program requirements in Year 4 will commence the MEng during Year 5.
- Eligible students may begin the master's program in the summer immediately following completion of fourth year of the bachelor's program.

The path to completion is:

Year 1: BSc requirements

Year 2: BSc requirements

Year 3: BSc requirements

Year 4: BSc requirements (including two FASE undergraduate half courses [to be determined] and up to 1.0 FCE of MEng requirements)

Year 5: MEng remaining requirements (studies may commence in summer between years 4 and 5)

Normal Program Length: 5 years full-time

Time Limit: BSc + 3 years MEng

Doctor of Philosophy

Minimum Admission Requirements

- Applicants may enter the program via one of three routes:
 1. following **completion of an MASc program** with a minimum B+ average and exceptional all-around scientific and intellectual ability as evidenced from theoretical or experimental research, academic standing, initiative, and publication record

2. **transferring from the University of Toronto MSc program** after completing one year; such students must successfully complete a “bypass” examination
 3. **direct entry** after completing a bachelor’s degree may be considered in exceptional cases
- International applicants with a master’s degree from outside Canada or the United States in their country of residence may be asked to register in the MSc program and follow entry route 2.

Program Requirements

- Thesis on a research topic.
- **Students with a completed MSc degree:** at least 2.0 full-course equivalents (FCEs).
- **Transfer students:** 3.0 FCEs for students without a master’s degree 2.0 FCEs for students with a completed master’s degree. Transfer students do not have to take a separate PhD qualifying examination.
- **Direct-entry students:** at least 3.0 FCEs.
- Courses must be selected from the calendar and approved by the student’s supervisor and the Graduate Coordinator. At least one of these courses must be taken in a minor area of study. It is recommended that one of these courses should be selected from Category A - Fundamental courses. Normally, PhD students are not allowed to take a 500-level course for credit towards the degree program. Students are also required to complete eight sessions of the seminar: attending CHE 300xH series and, if not already completed, CHE 2222H and JDE 1000H. Students are required to take a graduate student seminar: attending course two times in their program, once in the first year and once in the third year of study.
- Within 9–12 months of starting the PhD program, students must pass a qualifying examination. Students normally remain in residence (full-time, on campus) until the departmental recommendation for the Doctoral Final Oral Examination is made, unless special permission to do so has otherwise been granted by the departmental Graduate Studies Committee.

Normal Program Length: 4 years full-time; 5 years direct-entry; 5 years transfer-from-master’s

Time Limit: 6 years full-time; 7 years direct-entry; 7 years transfer-from-master’s

Course List

An updated course list and schedule is available on the departmental website at the beginning of each session listing the time and room location for each course. Not all courses are given every year.

All students wishing to undertake research and teaching in the Department of Chemical Engineering and Applied Chemistry must successfully complete an intensive occupational health and safety training workshop, CHE 2222H *Safety Workshop*, which normally takes place during the week immediately preceding the commencement of graduate courses in the fall. In each subsequent year of registration, students must take the WHMIS refresher workshop. Students registered in a graduate degree program involving research are required to participate in the non-credit seminar course JDE 1000H *Ethics in Research* during their first or second session of registration.

Category A: Fundamental Courses

CHE 1100H	Fundamentals of Chemical Engineering
CHE 1107H	Applied Mathematics
CHE 1141H	Advanced Chemical Reaction Engineering
CHE 1142H	Applied Chemical Thermodynamics
CHE 1143H	Transport Phenomena
JTC 1135H	Applied Surface Chemistry
CHE 1310H	Chemical Properties of Polymers

Category B: Specialized Courses

CHE 1053H	Electrochemistry
CHE 1118H	Industrial Catalysis
CHE 1123H	Liquid Biofuels
CHE 1125H	Modelling and Optimization of Chemical and Biomedical Networks
CHE 1134H	Advances in Bioengineering
CHE 1146H	Applied Transport Phenomena in Energy Systems
CHE 1147H	Data Mining in Engineering
CHE 1213H	Corrosion

CHE 1314H	The Structure and Properties of Fibrous Materials
JTC 1331H	Biomaterials Science
JCB 1349H	Molecular Assemblies: Structure/Function/Properties
CHE 1400H	Environmental Nuclear Science
CHE 1430H	Hydrometallurgy, Theory and Practice (MEng only)
CHE 1431H	Environmental Auditing (MEng only)
CHE 1432H	Technical Aspects of Environmental Regulations (MEng only)
CHE 1433H	Air Dispersion Modelling
CHE 1434H	Six Sigma for Chemical Processes
CHE 1533H	Nuclear Chemical Engineering
CHE 1541H	Two-Phase Flow and Heat Transfer
CHE 2504H	Environmental Pollution Prevention
JCC 1313H	Environmental Microbiology
JCI 1321H	Wood Engineering
JNC 2503H	Environmental Pathways Engineering Management Courses
APS 530H	Appropriate Technology and Design for Global Development
APS 1001H	Project Management
APS 1002H	Financial Engineering
APS 1003H	Professional Education and Instruction
APS 1004H	Human Resource Management: An Engineering Perspective
APS 1005H	Operations Research for Engineering Management
APS 1010H	Cognitive and Psychological Foundations of Effective Leadership
APS 1011H	Concepts and Application of Authentic Leadership
APS 1018H	History and Philosophy of Engineering
APS 1020H	International Business for Engineers
APS 1088H	Entrepreneurship and Business for Engineers
APS 1201H	Topics in Engineering and Public Policy 500-level (undergraduate/graduate) Courses
APS 1501H	Leadership and Leading in Groups and Organizations
CHE 507H	Process Modelling and Simulation
CHE 553H	Electrochemistry
CHE 561H	Risk Based Safety Management
CHE 564H	Pulp and Paper Processes
CHE 565H	Aqueous Process Engineering
CHE 568H	Nuclear Engineering
CHE 575H	Mechanical Properties of Bio-Composites and Biomaterials

Seminar Courses

CHE 2011H	Graduate Student Seminars (Credit/No Credit)
CHE 300xH	Seminars in Chemical Engineering and Applied Chemistry (Credit/No Credit)

In addition to the above courses, students may elect to take courses in other engineering or science departments where such courses are deemed relevant to the area of study. These courses require prior approval from the Graduate Coordinator.

Civil Engineering

Faculty Affiliation

Applied Science and Engineering

Degree Programs Offered

Civil Engineering – MAsc, MEng, BSc/MEng, PhD

Collaborative Programs

The following collaborative program is available to students in participating degree programs as listed below:

Environmental Engineering

- Civil Engineering, MAsc, MEng, PhD

Overview

The Department of Civil Engineering offers a graduate program in Civil Engineering leading to the **Master of Applied Science (MAsc)**, the **Master of Engineering (MEng)**, and the **Doctor of Philosophy (PhD)**. Qualified applicants are accepted for advanced studies in one of the following fields: Building Engineering, Environmental Engineering, Structural Engineering, Transportation Engineering, and Geomechanics.

Students registered in MAsc or PhD are required to participate in the non-credit seminar course JDE 1000H *Ethics in Research* during their first or second session of registration.

In addition, the Department of Civil Engineering offers the Combined Bachelor of Science (BSc)/Master of Engineering (MEng) degree program. This five-year program was established by the University of Toronto Scarborough (UTSC) and the Faculty of Applied Science and Engineering (FASE) for students who wish to combine graduate training in civil engineering and with a bachelor's degree in environmental science.

Contact and Address

Admission

Web: www.civil.engineering.utoronto.ca

E-mail: graduateadmissions@civ.utoronto.ca

Telephone: (416) 946-8028

Fax: (416) 978-6813

Program

Web: www.civil.engineering.utoronto.ca

Fax: (416) 978-6813

MEng

E-mail: shayni@civ.utoronto.ca

Telephone: (416) 978-5905

MAsc/PhD

E-mail: colin@civ.utoronto.ca

Telephone: (416) 978-0945

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Toronto, Ontario M5S 1A4
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Degree Programs

Civil Engineering

Master of Applied Science

Minimum Admission Requirements

- Applicants are admitted under the General Regulations of the School of Graduate Studies.
- Students who do not possess an undergraduate degree in civil engineering may be required to take more than the usual time and number of courses.

Program Requirements

- Each student, in consultation with a staff member at the beginning of the program, will establish the distribution of time between coursework and thesis or design project.
- Normally, a minimum of 2.5 full-course equivalents (FCEs) (five half courses) and a thesis. Some sections may require 3.0 FCEs (six half courses) and a thesis. Consult the supervisor and/or refer to the departmental graduate student handbook for further details.

Normal Program Length: 5 sessions full-time

Time Limit: 3 years full-time

Master of Engineering

Minimum Admission Requirements

- Applicants are admitted under the General Regulations of the School of Graduate Studies.
- Students who do not possess an undergraduate degree in civil engineering may be required to take more than the usual time and number of courses.

Program Requirements

- Each student, in consultation with a staff member at the beginning of the program, will establish the distribution of time between coursework and thesis or design project.
- Normally, 5.0 full-course equivalents (FCEs) (10 half courses) for the coursework-only program. Up to two half courses may be replaced by a research/design project.
- There is no formal residence requirement for MEng students; therefore, the program may be completed through part-time studies.

Normal Program Length: 3 sessions full-time; 5 sessions part-time

Time Limit: 3 years full-time; 6 years part-time

Combined Bachelor of Science (Environmental Science)/Master of Engineering

The Combined Program in Environmental Science (BSc) and Master of Engineering (MEng) allows well-qualified students in the four BSc Environmental Science Specialist programs (Environmental Biology, Environmental Chemistry, Environmental Geoscience, or Environmental Physics) to apply for and be considered for admission into the MEng program in Civil Engineering during the 3rd year of their undergraduate study and receive conditional admission to the graduate program then. Students in the combined program will complete it in less time than is normally the case for an MEng that follows upon a bachelor's degree.

Minimum Admission Requirements:

- Each student in the Combined Program shall meet the respective admission requirements of each program.
- To be eligible for admission into the MEng and the Combined Program, students must be enrolled full-time, and in good standing in one of the BSc specialist programs in Environmental Science (Environmental Biology, Environmental Chemistry, Environmental Geoscience, or Environmental Physics) with a CGPA of 3.3 or higher in Year 2.
- Admission into the MEng program is conditional upon students maintaining at least a CGPA of 3.3. in Years 3 and Year 4 of the BSc.
- Applications will be accepted in the third year of full-time registration in the BSc program.

Program Requirements:

- The full academic program requirements of both programs (BSc/MEng) will be met by students in the Combined Program.
- Students are required to remain registered as full-time students during Year 3 and 4 of the BSc and during the MEng.
- Complete two prescribed undergraduate engineering half courses (1.0 FCE) as part of the BSc degree requirements.
- Complete 10 half courses (5.0 FCEs) required for the Master of Engineering program
- Up to 1.0 FCE of the required master's courses normally are taken during Year 4 and count towards the BSc degree requirements and the MEng degree requirements.
- Students who receive conditional offers of admission during Year 3 of the bachelor's program and complete the bachelor's program requirements in Year 4 will commence the MEng during Year 5.

Eligible students may begin the master's program in the summer immediately following completion of fourth year of the bachelor's program. The path to completion is:

Year 1: BSc requirements

Year 2: BSc requirements

Year 3: BSc requirements

Year 4: BSc requirements (including two FASE undergraduate half courses [to be determined] and up to 1.0 FCE of MEng requirements)

Year 5: MEng remaining requirements (studies may commence in summer between years 4 and 5)

Normal Program Length: 5 years full-time

Time Limit: BSc + 3 years MEng

Doctor of Philosophy

Minimum Admission Requirements

- Applicants are admitted under the following departmental regulations, in addition to the SGS General Regulations and Degree Regulations for the PhD:
 - Satisfy the department of the ability to undertake advanced research.
 - Admission directly from a bachelor's degree is not normally permitted.
 - If a student transfers from a master's degree program to a PhD program, courses taken during the master's program may be applied to the PhD program.

Program Requirements

- A major and two minor fields of study, normally consisting of a minimum of 4.5 full-course equivalents (FCEs) (nine half courses) in total beyond the bachelor's degree. More FCEs may be required depending on the student's background preparation. It is normally expected that at least one of the minor fields will be taken outside of the department.
- PhD students with an MAsc degree (or equivalent in the same field) must take a minimum of 2.0 FCEs (four half courses) beyond the MAsc degree.
- Students enrolled in the MAsc degree program who transfer to the PhD program without submitting an MAsc thesis must complete a total of 4.5 FCEs (nine half courses) beyond the bachelor's degree program.
- Students with an MEng degree may use up to 3.0 FCEs (six graduate half courses) from the MEng program towards the PhD course requirements.
- Comprehensive examination after completing most of the coursework and preferably within one year after first enrolment in the PhD program. This examination consists of a four- to five-day take-home written examination, followed approximately a week later by an oral examination. The examination is administered by a Comprehensive Examination Committee created and supervised by the department's Examination and Degree Committee.
- Students normally must spend at least two academic years of their program on campus on a full-time basis.
- The academic program must be approved by the department's Examination and Degree Committee during the student's first session.
- Supervisors are required to establish a supervisory committee for their PhD students by the end of the second year of the student's program. This committee must include the supervisor and at least two graduate faculty members. Membership approval is not required.

Normal Program Length: 4 years full-time; 5 years direct-entry

Time Limit: 6 years full-time; 7 years direct-entry

Course List

Not all courses are given every year. Some courses may require a prerequisite. Please consult the department.

General Interest

CIV 1001H	M.Eng. Project I
CIV 1002Y	M.Eng. Project II
CIV 1099H	Special Studies in Civil Engineering
CIV 1307H	Life Cycle Assessment of Engineering Activities
CIV 1310H	Infrastructure Economics
CIV 1311H	Advanced and Sustainable Drinking Water Treatment
CIV 1337H	Simulation in Civil Engineering
CIV 1422H	Dynamic Response of Engineering Materials
CIV 1429H	Advanced Rock Engineering: Rock Engineering in Fractured Rock Masses
CIV 1504H	Applied Probability and Statistics for Civil Engineering
CIV 1539H	Evaluation of Civil Engineering Systems
CIV 1600H	Readings in Technology and Modern Society I
CIV 1601H	Readings in Technology and Modern Society II

Building Engineering

CIV 514H	Concrete Technology
CIV 575H	Building Science
CIV 1201H	Concrete Technology and Non-Destructive Testing Principles
CIV 1250H	Instrumentation Techniques in Concrete Technology
CIV 1252H	Repair and Maintenance of Concrete Structures
CIV 1277H	Construction Estimating and Finance
CIV 1278H	Pre-Project Planning and Constructability Analysis
CIV 1279H	Construction Contract Documents
CIV 1280H	Building Envelope Design
CIV 1281H	Asset Management
CIV 1282H	Case Studies in Building Science
CIV 1283H	Civil Informatics
CIV 1299H	Special Studies in Civil Engineering

Environmental Engineering

CIV 540H	Treatment Processes
CIV 549H	Groundwater Flow and Contamination
CIV 550H	Water Resources Engineering
CIV 1303H	Water Resources Systems Modelling
CIV 1305H	Water Resources Systems Analysis
CIV 1308H	Physical and Chemical Treatment Processes
CIV 1309H	Biological Treatment Processes
CIV 1319H	Chemistry and Analysis of Water and Wastes
CIV 1335H	Advanced Hydrogeology
CIV 1399H	Special Studies in Civil Engineering

Geomechanics

CIV 523H	Geotechnical Design
CIV 529H	Rock Engineering
CIV 1404H	Material Fracture Dynamics: Experimental Methods
CIV1410H	Satellite Positioning and Remote Sensing
CIV 1419H	Rock Dynamics
CIV 1420H	Soil Properties and Behaviour
CIV 1421H	Continuum Mechanics of Fluids and Solids
CIV 1446H	Slopes and Earthworks
CIV 1499H	Special Studies in Civil Engineering

Structural Engineering

CIV 510H	Solid Mechanics II
CIV 513H	Collaborative Engineering and Architectural Design Studio
CIV 517H	Prestressed Concrete Structures
CIV 518H	Behaviour and Design of Steel Structures
CIV 519H	Structural Analysis II
CIV 1163H	Mechanics of Reinforced Concrete
CIV 1164H	Bridge Engineering
CIV 1169H	Advanced Topics in Building Design
CIV 1167H	Advanced Structural Dynamics
CIV 1171H	Earthquake Engineering and Seismic Design
CIV 1174H	Finite Element Methods in Structural Mechanics
CIV 1175H	Design of Tubular Steel Structures
CIV 1180H	Advanced Modeling Methods for Seismic Performance Assessment of Structures
CIV 1185H	Seismic Design with Supplemental Damping and Isolation Systems
CIV 1199H	Special Studies in Civil Engineering
CIV 1361H	Reinforced and Prestressed Concrete Structures

Transportation Engineering and Planning

CIV 531H	Transport III—Planning
CIV 533H	Transport Operations
CIV 1505H	Transportation Research Seminar
CIV 1506H	Freight Transportation and ITS Applications
CIV 1507H	Public Transport
CIV 1508H	Airport Planning and Engineering
CIV 1520H	Travel Survey Methods
CIV 1535H	Transportation and Development
CIV 1532H	Fundamentals of ITS and Traffic Management
CIV 1538H	Transportation Demand Analysis
CIV 1540H	Urban Transportation Networks
CIV 1599H	Special Studies in Civil Engineering