UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

Report No. 3701 Revised

MEMORANDUM

To: Executive Committee of Faculty Council (November 24, 2021)
Faculty Council (December 16, 2021)

From: Professor Dionne Aleman
Associate Dean, Cross-Disciplinary Programs

Date: November 22, 2021

Re: Proposed Certificate in Public Health and Engineering

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 present and voting to carry).

BACKGROUND

Since the start of COVID-19, public health has been front-of-mind for many. Engineering as a discipline has strong historical connections to public health and direct connections currently to mitigating public health challenges and improving conditions for a healthier environment. A Certificate in Public Health and Engineering is proposed to provide students in the Core-8 engineering programs and Engineering Science with an introduction to public health and exposure to connections with Engineering that might spark an interest to explore careers or graduate studies in the area of public health through either Faculty.

PROCESS AND CONSULTATION

The proposal for a Certificate in Public Health and Engineering was co-developed by a committee from FASE and the Dalla Lana School of Public Health (DLSPH). It has been reviewed by and/or received input from the Faculty's Cross Disciplinary Programs Office; Institute for Studies in Transdisciplinary Engineering Education & Practice; and Undergraduate Curriculum Committee.

It has also has been reviewed by and/or received input from the DLSPH's Academic Affairs Office; and members of Centre for Global Health and Occupational & Environmental Health Division. The Health Studies Program at University College and the Department of Geography and Urban Planning were consulted regarding the inclusion of their courses in the certificate program.

RECOMMENDATION FOR COUNCIL

THAT a Certificate in Public Health and Engineering, as described in Report 3701 Revised, be approved effective September 2022.

University of Toronto
Proposal to Create a Certificate in Conjunction With an Undergraduate Program

Certificates offered in conjunction with an undergraduate program are for-credit undergraduate certificates governed by the Policy for Certificates (For-Credit and Not-For-Credit).

Proposed certificate name:	**Certificate in Public Health and Engineering**
Undergraduate degree(s) the certificate will be offered in conjuction with:	Any Engineering Bachelor's Degree (BASc or BASc in Engineering Science)
Faculty/academic division:	Faculty of Applied Science and Engineering (FASE)
Academic unit:	Cross-Disciplinary Programs Office, FASE
Dean's Office contact:	Dionne Aleman, Associate Dean, Cross Disciplinary Programs Caroline Ziegler, Faculty Governance and Programs Officer
Version date:	November 22, 2021

1 Summary

Since the start of the pandemic, public health has been front-of-mind for many. Engineering as a discipline has strong historical connections to public health and direct connections currently to mitigating public health challenges and improving conditions for a healthier environment. A certificate in engineering and public health is proposed to provide students in the Core-8 engineering programs and Engineering Science with exposure to the connections between the two disciplines. This program will provide students with an introduction to public health that might spark an interest to explore careers or graduate studies in the area of public health through either faculty.

2 Effective Date

September 1, 2022

3 Academic Rationale

The connection between engineering and public health has a long history. Innovation in areas such as clean drinking water and sanitation enabled the development of today's cities. Many shared challenges remain in relation to home and occupational exposures and the impact of environmental pollution on health. Most recently, the COVID-19 pandemic has further increased interest in public health, from the design and production of new personal protective equipment, optimization of building systems, development of new disinfecting tools and modeling viral transmission. Moreover, transformation of global infrastructure over the coming decade to mitigate climate change will increasingly require engineers who are able to recognise and leverage public health connections.

The Dalla Lana School of Public Health (DLSPH) is graduate faculty at the University of Toronto with a diverse student intake, including some engineering graduates. DLSPH is excited to work with the Faculty of Applied Science and Engineering (FASE) to introduce public health to engineering students to better prepare them for professional practice, and also to highlight an opportunity for future graduate studies. Many engineering courses already include aspects of public health, as evidenced by the engineering electives within the proposed program. The certificate provides an opportunity for students to learn about public health within the context of engineering applications and expand their understanding of the social and historical implications of engineering.

4 Need and Demand

Although the certificate will be open to any engineering discipline, we anticipate that it will likely appeal most to students in Chemical, Civil and Industrial Engineering.

We anticipate an initial enrolment in the core course of about 20-25 students. Completion of the certificate will depend on availability of, and student interest in, the engineering courses and the public health focused electives connected to the certificate.

Enrolment spaces in the FAS elective courses will be secured in agreement with the departments and programs and the FAS/FASE Interdivisional Teaching Agreement. The Department of Geography and Urban Planning, and the Health Studies Program (University College) have been consulted and are supportive of the inclusion of these courses and the creation of dedicated enrolment spaces.

5 Admission Requirements

There are no admission requirements for engineering certificate programs. If an eligible student completes the course requirements, they will be awarded the certificate program at the time of graduation. The certificate is open to all undergraduate students in any engineering discipline.

6 Program Requirements

The certificate consists of three half-course requirements, totaling 1.5 FCE. The courses can be completed as part of the elective credits in a student's program or taken as Extra credits (not counting towards their degree requirements).

Students are required to take a newly created core course, APS470H1, one public health focused course from the Faculty of Arts & Science (FAS), and one engineering elective related to public health. DLSPH is a graduate faculty, however they are directly involved with a number of FAS courses which we have included in this program.

1. APS470H1 – Engineering and Public Health (new course)
2. One Public Health elective from the Faculty of Arts & Science:
    - HST209H1 – Introduction to Health: Determinants of Health & Health Care
    - HST211H1 – Health Policy in Canada
    - HST330H1 – Population Health
    - GGR433H1 – Built Environment and Health
    - GGR434H1 – Building Community Resilience
3. One Public Health-related Engineering elective:
    - CHE416H1 – Chemical Engineering in Human Health
    - CHE561H1 – Risk-Based Safety Management
    - CHE460H1 – Environmental Pathways and Impact Assessment
    - CIV536H1 – Urban Activities, Air Pollution and Health
    - CIV577H1 – Infrastructure for Sustainable Cities

- CIV550H1 – Water Resources Engineering
- MIE368H1 – Analytics in Action
- MIE542H1 – Human Factors Integration
- MIE561H1 – Healthcare Systems

In the future, we hope to add to the course options in Requirement 2 through the creation of new courses in this area or creating co-taught undergraduate versions of some of DLSPH's graduate courses.

7 Consultation

Over the last year, this program was co-developed by a committee from FASE and DLSPH. The committee members were as follows:

Engineering:

- Dionne Aleman – Incoming Associate Dean, Cross-Disciplinary Programs
- Bryan Karney – Former Associate Dean, Cross-Disciplinary Programs
- Greg Evans – Director, Institute for Studies in Transdisciplinary Engineering Education & Practice (ISTEP)
- Sharon Brown – Assistant Director, Cross-Disciplinary Programs Office

Dalla Lana School of Public Health:

- Dionne Gesink – Associate Dean, Academic Affairs
- Victoria Arrandale – Assistant Professor, Occupational & Environmental Health Division, Centre for Global Health
- Jeffrey Brook – Assistant Professor, Occupational & Environmental Health Division
- James Scott – Professor, Occupational & Environmental Health Division

The Health Studies Program (University College), the Human Biology Program and the Department of Geography and Urban Planning were consulted regarding the inclusion of their courses in the certificate program.

The FASE Undergraduate Curriculum Committee has endorsed the proposal. The proposal has also been presented to the DLSPH faculty and School Council for consultation and has been endorsed by DLSPH Dean (Prof. Adalsteinn Brown); DLSPH

Associate Dean, Academic Affairs (Prof. Dionne Gesink); and FAS Vice-Dean, Academic Operations (Prof. Jamie Stafford).

8 Resources

Administration of the certificate program will be managed through the Cross-Disciplinary Programs Office as part of its regular activities. No additional resources will be required for the program itself.

Funding for instruction for the new Engineering and Public Health core course (APS470H1) will come from a new interdivisional teaching agreement currently under development between DLSPH and FASE.

Spaces in the existing FAS courses in Requirement #2 will be included in FASE's annual IDT request. The Engineering electives in Requirement #3 already exist in other departments within their regular budgets.

9 Oversight & Accountability: Review

Minors and certificates in the Faculty of Applied Science and Engineering are subject to periodic review in conjunction with the review of the Cross-Disciplinary Programs Office.

Summary of Process Steps & Approvals

Steps	**Dates of Consultation and Approvals**
Development/consultation within CDPO	October 2020-October 2021
Endorsement by the FASE Undergraduate Curriculum Committee	October 29, 2021
Consultation with Dean's Office	October-November 2021
DLSPH presentation and endorsement	November 2021
FAS endorsement	November 2021
Consultation with VPAP	November 2021
FASE Council approval	December 16, 2021
Submission to VPAP upon approval	December 2021
Reported by VPAP to AP&P	June 2022

Appendix A: Proposed Learning Outcomes and Undergraduate Degree-Level Expectations

The Faculty of Applied Science and Engineering aims to provide all of its undergraduate students with an education that will encourage them to be leaders in society in developing solutions to its most pressing problems. In order to achieve this, each graduate will have achieved the Undergraduate Degree-Level Expectations for the BASc described below.

Engineering minors and certificates are designed to recognize students for focusing their degree-program electives in a particular area of study. They are optional structures above and beyond a student's degree requirements and are therefore enhancements to existing rigorous degree-level expectations for engineering programs.

The certificate is structured around a broad, interdisciplinary introduction to the field (APS470H), deeper exposure to public health concepts through the courses at FAS and making further connections to public health through their engineering discipline elective.

In addition to the following Undergraduate Degree-Level Expectations, upon completion of the certificate program, students will be able to:

1. Recognise and critically assess public health dimensions of current and proposed engineering activities;
2. Communicate effectively with public health specialists so as to foster multidisciplinary collaboration;
3. Transfer engineering knowledge to public health related challenges and applications.

Degree Level Expectations for Graduates
Receiving the Degree of Bachelor of Applied Science

Faculty of Applied Science and Engineering
University of Toronto

1. Degree Learning Objectives and Requirements

Overall Learning Objectives

The Faculty of Applied Science and Engineering aims to provide all of its undergraduate students with an education that will allow them to be leaders in society in developing solutions to its most pressing problems. Our graduates will be able and inspired to:

- be leading practitioners of engineering and engineering design
- be known for their technical literacy as well as their knowledge of mathematics and the basic sciences and the role of technology in society
- be able to formulate and solve problems in complex systems independently and in teams
- pursue independent lifelong learning within their field of study and more broadly
- be prepared for careers, including graduate programs, that build upon their advanced technical knowledge
- participate meaningfully as leaders in society

In order to achieve this, each graduate will have achieved the following general learning objectives:

a. Depth of knowledge that cultivates critical understanding and intellectual rigour in at least one engineering discipline.
b. Competencies in learning and applying knowledge to solve problems facing society and that are fundamental to responsible and effective participation in the workplace, in the community, in scholarly activity, and in personal life:
    i. Critical and Creative Thinking
    ii. Oral and Written Communication
    iii. Quantitative Reasoning
    iv. Teamwork
    v. Information Literacy
    vi. Ethical Thinking and Decision-Making
c. Breadth of knowledge across mathematics, basic sciences, engineering sciences, engineering economics and engineering design that cut across the engineering disciplines and across a range of nontechnical areas including the humanities and social sciences and an awareness of the impact of technology on society.
d. Integration of skills and knowledge developed in a student's course of study through a capstone experience in the upper years.

Requirements to Graduate

In order to graduate with a BASc degree, each student in the Faculty of Applied Science and Engineering will have completed a full undergraduate program as outlined in the Faculty Calendar within nine calendar years of first registration, exclusive of mandatory absences from his/her program. Current programs include: Chemical, Civil, Computer, Electrical, Industrial, Mineral, Materials and Mechanical Engineering as well as the BASc in Engineering Science.

The practice of engineering is regulated, by statute, in all Canadian provinces and territories. To become a Professional Engineer (PEng), an individual must satisfy the requirements of the licensing bodies.

These requirements include a degree from an accredited program, successful completion of a professional practice examination in engineering law and ethics, and suitable experience. At present, all programs in the Faculty of Applied Science and Engineering are accredited and evaluated regularly by the Canadian Engineering Accreditation Board (CEAB) of the Canadian Council of Professional Engineers. Therefore, graduation from the Faculty may lead to registration in the provincial Associations of Professional Engineers, in accordance with individual policies. No student will be permitted to graduate who does not meet these requirements.

The criteria set out by the CEAB are designed to ensure that each graduate has a foundation in Mathematics and Basic Sciences, a broad preparation in Engineering Sciences and Engineering Design and an exposure to non-technical subjects (Complementary Studies) that complement the technical aspects of the curriculum. Basic Sciences must include physics and chemistry and also may include elements of life sciences and earth sciences; they impart an understanding of natural phenomena. Engineering Sciences normally involve Mathematics and Basic Sciences but carry knowledge further to creative applications. Complementary Studies include the humanities, social sciences, arts, management, engineering economics and communication skills.

Each program in the Faculty consists of a technical component and complementary studies component. The curriculum for students in their early years forms a basis in the fundamental subjects prior to subsequent specialization in the various engineering disciplines. Students are able to choose from a range of technical electives in their senior years. In the senior years, all programs contain a capstone experience through a design project, which integrates their skills and knowledge and provides students with the opportunity to carry out original work in their chosen fields of study.

There are a set of common requirements, described below, that cut across all programs in the following categories: Coursework, Promotion, English Proficiency, and Practical Experience. In this context, a course is defined as one half-course equivalent, which may consist of a half course (“S”, “F” or “H”) or half of a full-year “Y” course.

1. **Coursework:** Each program will have courses that provide the following:
    a. Complementary Studies Electives
    b. A basic knowledge of Engineering Economics
    c. Technical Electives

d. Courses with substantial design content in Years 1, 2 and/or 3
e. Capstone course(s) in Years 3 and/or 4 with strong integrative, design and independent work elements
f. Across all four years, programs will provide sufficient opportunities for the development of professional awareness and practice.

2. **Promotion:** All undergraduate programs will consist of eight Fall and Winter Sessions taken in order.

    a. To gain credit for a session a student must:
        i. satisfy the academic regulations to proceed to the succeeding session as described in the calendar and
        ii. not be subsequently required to repeat the session for which credit is to be gained, and
        iii. achieve a course mark of 50% or greater in every course taken as part of the academic load in a session, and
        iv. not have any outstanding designations of 'standing deferred', 'incomplete' or 'No Grade Available' for any course in any session.

    b. To be eligible to graduate, each student must attain a weighted Session Average of 60% or greater in the final session of their program. Any student who does not achieve a weighted Session Average of 60% in their final session (4W), but has attained a weighted Session Average that allows them to proceed to the next session on probation, shall repeat the final session and achieve a weighted Session Average of 60% or greater to graduate.

3. **English Proficiency:** Each student must show an ability to write English coherently and correctly. Every student will also take at least one course that includes a written communication component within their curriculum. Satisfactory completion of the course or courses is required for graduation.

4. **Practical Experience:** The Faculty requires that all students complete a minimum of 600 hours of practical work before graduation.

2. Degree Level Expectations for the Bachelor of Applied Science

Depth and Breadth of Knowledge

The Faculty ensures that a student has mastered a body of knowledge with appropriate depth by requiring that each student completes the requirements of one of the degree Programs of Study (POSt) as described in the Faculty Calendar. The curriculum for students in First Year forms a common basis in the fundamental subjects, including the natural sciences and mathematics, prior to a subsequent specialization in the various engineering disciplines. Each program consists of a technical component and a complementary studies component.

Critical analysis and thinking and analytical skills are emphasized through the student's exposure to an increasingly sophisticated understanding of their program of study. Specialization within the discipline is developed through technical electives taken in the 3rd and 4th years of study. A detailed knowledge of and experience in design is ensured through

the Design Course requirements, beginning with courses in the first three years as well as the Capstone course(s) in each program. Opportunity to further develop these skills is provided through a research thesis that is available in most POSts.

The Faculty assures that students have breadth of knowledge in a number of ways. Breadth across engineering is assured through a First Year of study that prepares a student for any of the programs of study. Breadth beyond engineering is developed through the Complementary Studies Electives as well as the Engineering Economics requirement.

Knowledge of Methodologies

Every POSt has requirements which demonstrates a student's understanding of the methods of engineering design. Students in all engineering programs must successfully complete courses with substantial design in their first three years and a Capstone design course in their senior years. These courses require students to evaluate the appropriateness of various approaches to analyze and solve the design problem and also to devise and sustain arguments for their design. In most POSts, students have the opportunity to participate in a research thesis course that familiarizes them with the specific methodologies currently in use in the development of knowledge in their discipline.

Application of Knowledge

The application of science and mathematics to solve problems is fundamental to all programs in Engineering and therefore is required in many of the courses within all POSt. A minimum level of instruction in Engineering Science and Engineering Design is required, both of which directly involve the application of knowledge.

Communication Skills

The Faculty requires students to communicate information, arguments and analysis accurately and reliably, orally and in writing, to specialist and non-specialists audiences. The requirement for courses with substantial engineering design that are required across all programs require a series of technical reports and presentations with direct involvement with our Engineering Communication Program. In addition, our Capstone Design Courses and research theses all involve a written report and most involve oral presentations. The course requirements for instruction in Complementary Studies also adds to the education our students receive in communication skills. Also, the English Proficiency requirement insures a minimum level of writing ability for all graduates.

Awareness of Limits of Knowledge

Each POSt develops, through a sequence of courses starting at the 100-series or 200-series and culminating at the 300-series or 400-series or 500-series of courses, an understanding of a discipline as it is currently appreciated by educators who are at the same time involved in original scholarship in the subject area. The course content at the upper series level is designed, in part, to provide students with an appreciation of the uncertainties, ambiguities and limitations of knowledge in the specific area.

Autonomy and Professional Capacity

The development of an awareness and understanding of professional practice is required for all POSt. The required design courses require students to work in teams and also accept responsibility for their own contributions. Students are required to make their own decisions for their own learning through selection of their technical and nontechnical electives. Finally, in completing their course requirements, the Faculty expects strict adherence by students to the Code of Behaviour on Academic Matters, which requires students to not tolerate or encourage the creation of an environment of cheating, misrepresentation or unfairness.

3. Other Degree Level Expectations

The Faculty requires all students to have developed competency in several areas of learning and applying knowledge not identified explicitly in the previous sections. In particular, the Faculty requires students to have developed competencies in quantitative reasoning and in information literacy.

Quantitative reasoning is considered the ability to identify, assemble and interpret quantitative information and make and test hypotheses based on such data. Development of this competency is an explicit part of all POSts offered by the Faculty.

The Faculty requires all students to develop an advanced understanding of how to obtain information, manipulate and evaluate it and bring diverse sources together to develop a comprehensive understanding of specific issues, solve problems or apply the scientific method to create further knowledge in the discipline. These advanced information literacy skills are developed through the studies in their concentration(s) and are demonstrated in the advanced courses required in each POSt.

Appendix B: Proposed Calendar Copy

Course Requirements for the Certificate in Engineering and Public Health

The connection between engineering and public health has a long history. Innovation in areas such as clean drinking water and sanitation enabled the development of today's cities. Many shared challenges remain in relation to home and occupational exposures and the impact of environmental pollution on health. Most recently, the COVID-19 pandemic has further increased interest in public health, from the design and production of new personal protective equipment, optimization of building systems, development of new disinfecting tools and modeling viral transmission. Moreover, transformation of global infrastructure over the coming decade to mitigate climate change will increasingly require engineers who are able to recognise and leverage public health connections.

All undergraduate Engineering students are eligible to participate in this certificate program. Students who complete the requirements of the Certificate will receive a notation on their transcript upon graduation.

The requirements for the Certificate are the successful completion of the following courses:

1. APS470H1 – Engineering and Public Health
2. One Public Health elective from the Faculty of Arts & Science:
    - HST209H1 - Introduction to Health: Determinants of Health & Health Care
    - HST211H1 – Health Policy in Canada
    - HST330H1 - Population Health
    - GGR433H1 – Built Environment and Health
    - GGR434H1 – Building Community Resilience
3. One Public-health related Engineering elective:
    - CHE416H1 – Chemical Engineering in Human Health
    - CHE561H1 – Risk-Based Safety Management
    - CHE460H1 – Environmental Pathways and Impact Assessment
    - CIV536H1 – Urban Activities, Air Pollution and Health
    - CIV577H1 – Infrastructure for Sustainable Cities
    - CIV550H1 – Water Resources Engineering
    - MIE368H1 – Analytics in Action
    - MIE542H1 – Human Factors Integration
    - MIE561H1 – Healthcare Systems

Notes:
Availability of the courses (including the foundational courses) for timetabling purposes is not guaranteed; the onus is on the student to ensure compatibility with their timetable. Students must secure approval from their home department before selecting any elective outside their departmental approved list.

Courses	Term	Lec	Lab	Tut	Wgt
Fall Courses					
APS470H1 – Engineering and Public Health	F	3		1	0.5
CIV536H1 – Urban Activities, Air Pollution and Health	F	3			0.5
CIV550H1 – Water Resources Engineering	F	3		2	0.5
HST209H1 – Introduction to Health: Determinants of Health & Health Care	F	3			0.5
MIE368H1 – Analytics in Action	F	2	3	1	0.5
Winter Courses					
CHE416H1 – Chemical Engineering in Human Health	S	3		1	0.5
CHE460H1 – Environmental Pathways and Impact Assessment	S	3		2	0.5
CHE561H1 – Risk-Based Safety Management	S	3		1	0.5
CIV577H1 – Infrastructure for Sustainable Cities	S	3		1	0.5
GGR433H1 – Built Environment and Health	S	3			0.5
GGR434H1 – Building Community Resilience	S	3			0.5
HST211H1 – Health Policy in Canada	S	3			0.5
HST330H1 – Population Health	S	2			0.5
MIE542H1 – Human Factors Integration	S	3		2	0.5
MIE561H1 – Healthcare Systems	S	3		1	0.5