UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

MEMORANDUM

To: Executive Committee of Faculty Council (April 6, 2022)
Faculty Council (April 27, 2022)

From: Professor Julie Audet
Chair, Engineering Graduate Education Committee (EGEC)

Date: March 8, 2022

Re: **Closure of Program Fields of Study in Mechanical & Industrial 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).

PROPOSED

It is proposed to close all program fields of study in the Department of Mechanical & Industrial Engineering (MIE). Fields of study were historically a requirement of the Ontario Council on Graduate Studies and allowed these areas to be advertised as areas of strength within the department; however, they were never used to formally classify or group students in any University system.

The department and the Faculty have since created a suite of emphases that provide students with optional areas of focus which better serve the needs of MIE students.

CONSULTATION PROCESS

The proposal to close MIE's program fields study was developed in consultation within the Faculty. Since faculty don't engage with the fields, there were no concerns. Similar to faculty, students don't engage with the fields; as such they will not be impacted by the change.

RECOMMENDATION FOR COUNCIL

> THAT the closure of all program fields of study in the Department of Mechanical & Industrial Engineering, as described in Report 3718, be approved.

University of Toronto
Major Modification Proposal

Significant Modifications to Existing Graduate and Undergraduate Programs

This template should be used to bring forward all proposals for major modifications to existing graduate and undergraduate programs for governance approval under the University of Toronto's Quality Assurance Process.

Program being modified:	MEng, MASc and PhD in Mechanical and Industrial Engineering
Proposed major modification:	Closure of all Program Fields of Study
Department/unit:	Mechanical and Industrial Engineering (MIE)
Faculty/academic division:	Applied Science and Engineering (FASE)
Dean's office contacts:	Prof. Julie Audet, Vice-Dean, Graduate (FASE) Caroline Ziegler, Governance & Programs Officer (FASE)
Proponent:	Prof. Tobin Filleter, Associate Chair, Graduate Studies (MIE)
Version date:	February 16, 2022

1. Summary

This proposal is to close the following fields of study in the MEng, MASc and PhD in Mechanical and Industrial Engineering:

- Advanced Manufacturing and Materials Engineering
- Applied Mechanics and Design
- Biomedical Engineering
- Energy and Environmental Engineering
- Human Factors/Ergonomics
- Information Engineering
- Operations Research
- Robotics, Mechatronics and Instrumentation
- Thermal and Fluid Sciences Engineering

These fields were approved during the time when the Ontario Council of Graduate Studies (OCGS) governed quality assurance in Ontario. The creation of the fields allowed for these areas to be advertised as areas of strength within the Department. However, the Department never

formally grouped degree programs students into these specific fields, and program requirements for the MEng, MASc and PhD remained the same regardless of a student's area of specialization. Since the existing fields belong to an earlier time and were never used to formally classify or group students in any University systems, the existing fields will close.

2. Effective Date

September 1, 2022.

3. Academic Rationale

Prior to 2011 and the establishment of the current Ontario quality assurance processes, when graduate programs were reviewed and approved by the Ontario Council on Graduate Studies (OCGS), each graduate program was required to have a least one field, which led to the creation of the existing fields. Historically the existing fields functioned solely as informal research themes, and not formal fields. The fields do not have specific admission or program requirements associated with them. Students do not apply to these fields, they are not admitted or enrolled in a field, and they do not graduate with a field designation on their academic record.

Furthermore, as of the 2015-16 academic year, MIE (and the FASE) have created a suite of emphases that provide students with optional areas of focus which better serve the needs of MIE students (see Appendix A for complete Calendar copy, showing changes).

4. Description of the Proposed Major Modification(s)

The proposal to close the fields does not involve any change to the MEng, MASc and PhD in Mechanical and Industrial Engineering program requirements. All programs will continue to have undifferentiated program requirements for all students.

There is no change to the program learning outcomes of any of the identified degree programs as a result of the closure of the fields.

5. Impact of the Change on Students

There is no impact on continuing or new students. The identified fields were never used to group students in a formal way in University systems. Although the fields were created as Subject POSts in ROSI, MIE never used the Subject POSts to track students. The fields have not appeared on students' transcripts. The field never appeared in the SGS Calendar entry.

Instead, the emphases discussed in section 3 of this proposal provide students with opportunities to focus on academic areas that the fields do not provide.

6. Consultation

There has been consultation within the Faculty on the plan to close the fields. Since faculty don't engage with the fields, there were no concerns. Similar to faculty, students don't engage with the fields; as such they will not be impacted by the change.

Faculty will be notified by the MIE Chair's office about closing the fields.

7. Resources

There are no resource implications to closing the fields. There is no expected impact on faculty workload.

8. UTQAP Process

The UTQAP pathway is summarized in the table below.

Steps and Approvals	Dates
Development/consultation within unit (MIE)	November 2021-March 2022
Consultation with the Dean's office	November 2021-March 2022
Consultation with VPAP and sign-off	March 2022
Approval of Faculty Council	April 27, 2022
Submission to Provost's office	April 27, 2022
Reported to the Provost and included in annual report to AP&P	2022
Ontario Quality Council—reported annually	2022

Appendix A: Current Calendar Copy with Changes Tracked

Exported on June 14, 2021.

*Note: changes are isolated to the "Overview" section; there are no other changes.

MIE: Introduction
Faculty Affiliation
Applied Science and Engineering

Degree Programs

Mechanical and Industrial Engineering
MASc

- *Emphases:*
  o Robotics;
  o Sustainable Energy

MEng

- *Emphases:*
  o Advanced Manufacturing;
  o Advanced Soft Materials;
  o Analytics;
  o Biomanufacturing;
  o Engineering and Globalization;
  o Entrepreneurship, Leadership, Innovation and Technology in Engineering (ELITE);
  o Forensic Engineering;
  o Robotics;
  o Sustainable Energy
- *Dual Degree Program:*
  o BEng (South China University of Technology) / MEng (University of Toronto)

PhD

- *Emphases:*
  o Robotics;
  o Sustainable Energy

Collaborative Specializations

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

- *Biomedical Engineering*
  - Mechanical and Industrial Engineering, MASc, PhD
- *Engineering Education*
  - Mechanical and Industrial Engineering, MASc, PhD
- *Knowledge Media Design*
  - Mechanical and Industrial Engineering, MASc, MEng, PhD
- *Psychology and Engineering*
  - Mechanical and Industrial Engineering, MASc, PhD
- *Resuscitation Sciences (admissions have been administratively suspended)*
  - Mechanical and Industrial Engineering, MASc, MEng, PhD

Overview

The Department of Mechanical and Industrial Engineering accepts qualified applicants for study in a wide range of topics, spanning the breadth of mechanical and industrial engineering, including ~~advanced manufacturing and materials engineering; applied mechanics and design; biomedical engineering; energy and environmental engineering; robotics, mechatronics and instrumentation; thermal and fluid sciences engineering; human factors/ergonomics; information engineering; and operations research~~; mechanics & design; materials; thermofluids; human factors; information engineering; operations research; and applied machine learning.

Contact and Address

Web: www.mie.utoronto.ca/contact-us/
Email: gradoffice@mie.utoronto.ca
Telephone: (416) 978-2805

Department of Mechanical and Industrial Engineering
University of Toronto
Mechanical Engineering Building
5 King's College Road
Toronto, Ontario M5S 3G8
Canada

MIE: Mechanical and Industrial Engineering MASc

Master of Applied Science

Program Description
The MASc degree program provides students with an opportunity to pursue research-intensive advanced studies in a particular field of interest.

Minimum Admission Requirements
- *Applicants are admitted under the General Regulations of the School of Graduate Studies. Applicants must also satisfy the Department of Mechanical and Industrial Engineering's additional admission requirement stated below.*
- *Evidence of research ability.*

Program Requirements
- *At the beginning of each student's program, a professor in the department will be identified as the supervisor who will guide the student in the research program and selection of courses.*
- *For students with an adequate undergraduate background, the program will normally consist of 2.0 full-course equivalents (FCEs) and a thesis.*
- *MASc students are required to participate in the non-credit seminar course JDE1000H during their first or second session of registration.*
- *In Year 1, MASc students are required to attend at least 70% of seminars that are part of the MIE Seminar Series. Students who complete the requirement will receive credit for SRM3333Y MIE Seminar Series for MASc Students.*
- *Students in the MASc program have the option of completing an emphasis in Robotics or Sustainable Energy as part of their degree program. Please see details in the Mechanical and Industrial Engineering MASc, MEng, PhD Emphases section.*

Program Length
6 sessions full-time (typical registration sequence: F/W/S/F/W/S)

Time Limit
3 years full-time

MIE: Mechanical and Industrial Engineering MEng

Master of Engineering

Program Description
The MEng degree program is designed for students preparing for advanced professional activity; it is not a research-oriented degree. The program may be taken on a full-time, extended full-time, or part-time basis.

Full-Time Option

Minimum Admission Requirements
- *Applicants are admitted under the General Regulations of the School of Graduate Studies. Applicants must also satisfy the Department of Mechanical and Industrial Engineering's additional admission requirements stated below.*
- *A mid-B in the final two years of undergraduate study.*

Program Requirements
- *5.0 full-course equivalents (FCEs) or 3.5 FCEs plus a supervised project. A majority of the courses must be either offered by the Department of MIE or from a list (found on the department website) of approved courses deemed equivalent to an MIE course.*
- *Program completion is possible in three sessions (one year).*
- *Students in the MEng program have the option of completing an emphasis in Advanced Manufacturing; Analytics; Biomanufacturing; Engineering and Globalization; Entrepreneurship, Leadership, Innovation and Technology in Engineering (ELITE); Forensic Engineering; Robotics; or Sustainable Energy as part of their degree program. Please see details in the Mechanical and Industrial Engineering MASc, MEng, PhD Emphases section.*

Program Length
3 sessions (typical registration sequence: F/W/S);

Time Limit
3 years

Extended Full-Time Option

Minimum Admission Requirements
- *Applicants are admitted under the General Regulations of the School of Graduate Studies. Applicants must also satisfy the Department of Mechanical and Industrial Engineering's additional admission requirement stated below.*
- *A mid-B in the final two years of undergraduate study.*

Program Requirements
- *5.0 full-course equivalents (FCEs) or 3.5 FCEs plus a supervised project. A majority of the courses must be either offered by the Department of MIE or from a list (found on the department website) of approved courses deemed equivalent to an MIE course.*
- *Students are expected to complete the requirements in six sessions (two years) and are limited to seven half courses per year and three half courses per session.*
- *Students in the MEng program have the option of completing an emphasis in Advanced Manufacturing; Analytics; Biomanufacturing; Engineering and*

Globalization; Entrepreneurship, Leadership, Innovation and Technology in Engineering (ELITE); Forensic Engineering; Robotics; or Sustainable Energy as part of their degree program. Please see details in the Mechanical and Industrial Engineering MASc, MEng, PhD Emphases section.

Program Length
6 sessions (typical registration sequence: F/W/S/F/W/S)

Time Limit
3 years

Part-Time Option

Minimum Admission Requirements
- *Applicants are admitted under the General Regulations of the School of Graduate Studies. Applicants must also satisfy the Department of Mechanical and Industrial Engineering's additional admission requirement stated below.*
- *A mid-B in the final two years of undergraduate study.*

Program Requirements
- *5.0 full-course equivalents (FCEs) or 3.5 FCEs plus a supervised project. A majority of the courses must be either offered by the Department of MIE or from a list (found on the department website) of approved courses deemed equivalent to an MIE course.*
- *Students are limited to four half courses per year and two half courses per session. Time to completion will be greater than two years.*
- *Students in the MEng program have the option of completing an emphasis in Advanced Manufacturing; Analytics; Biomanufacturing; Engineering and Globalization; Entrepreneurship, Leadership, Innovation and Technology in Engineering (ELITE); Forensic Engineering; Robotics; or Sustainable Energy as part of their degree program. Please see details in the Mechanical and Industrial Engineering MASc, MEng, PhD Emphases section.*

Program Length
9 sessions

Time Limit
6 years

MIE: Mechanical and Industrial Engineering MEng (Dual Degree: BEng South China University of Technology) / MEng)

Dual Degree Program: Bachelor of Engineering (South China University of Technology) / Master of Engineering (University of Toronto)

Program Description
The MEng may also be taken as part of a dual degree involving the Bachelor of Engineering (BEng) program offered by the South China University of Technology's School of Mechanical and Automotive Engineering (SMAE) and the Master of Engineering program offered by the University of Toronto's Mechanical and Industrial Engineering (MIE) department. Dual degree program students complete the fourth year of their BEng as Visiting International Non-degree Students and receive a conditional offer to the MEng program. See the MEng requirements above.

Upon successful completion of the degree requirements of both programs, students receive a Bachelor of Engineering degree and a Master of Engineering degree.

Contact
Bachelor of Engineering Program
School of Mechanical and Automotive Engineering
South China University of Technology
Email: j2jw@scut.edu.cn

Master of Engineering Program
Department of Mechanical and Industrial Engineering
Faculty of Applied Science and Engineering, University of Toronto
Email: meng.admission@mie.utoronto.ca

Application Process
- *This dual degree program allows outstanding third-year students at SMAE to apply to complete their fourth year of undergraduate studies enrolled in MIE as Visiting International Non-degree Students. These students receive a conditional offer of admission into the MEng program for their fifth year.*

Minimum Admission Requirements
- *Applicants are admitted under the General Regulations of the School of Graduate Studies. Applicants must also satisfy the Department of Mechanical and Industrial Engineering's additional admission requirements stated on the department's website.*

- *In Years 2 and 3 of the BEng program, a minimum 80% average (mid-B). In Year 4, students must maintain a minimum mid-B average until conferral of the BEng degree.*

MIE: Mechanical and Industrial Engineering PhD

Doctor of Philosophy

The PhD degree program is for students anticipating a career in which they will be performing or directing research at the most advanced level.

Students may be admitted to the PhD program via one of three routes: 1) following completion of an appropriate master's degree; 2) transfer from the University of Toronto MASc program; or 3) direct entry following completion of a bachelor's degree.

The Department of Mechanical and Industrial Engineering offers both full-time and flexible-time PhD program options. Applicants must declare the option for which they wish to apply; transfers between these programs are not permitted.

PhD Program

Minimum Admission Requirements
- *Applicants are admitted under the General Regulations of the School of Graduate Studies. Applicants must also satisfy the Department of Mechanical and Industrial Engineering's additional admission requirements stated below.*
- *Admission to the PhD program is reserved for those who are able to present evidence of superior academic and research ability. Students may be admitted to the PhD program with an appropriate University of Toronto master's degree or its equivalent from a recognized university with a minimum B+ average.*

Program Requirements
- *At the beginning of each student's program, a professor in the department will be identified as the supervisor and will guide the student in the research program and selection of courses.*
- *Minimum departmental standards in coursework: completion of 2.5 full-course equivalents (FCEs) plus a thesis.*
- *Participation in the non-credit seminar course JDE1000H during the first or second session of registration.*

- *In Years 1 and 2, students must attend at least 70% of seminars that are part of the MIE Seminar Series. Students who complete this requirement will receive credit for SRD4444Y MIE Seminar Series.*
- *Students must pass a qualifying examination, annual progress meetings, and the SGS Doctoral Final Oral Examination.*
- *Students must present a research seminar during the final year of their studies.*
- *Students must be on campus full-time unless special permission is obtained for off-campus study.*
- *Students have the option of completing an emphasis in Robotics or Sustainable Energy as part of their degree program. Please see details in the Mechanical and Industrial Engineering MASc, MEng, PhD Emphases section.*

Program Length
4 years

Time Limit
6 years

PhD Program (Transfer)

Transfer Requirements
- *Admission to the PhD program is reserved for those who are able to present evidence of superior academic and research ability. Very strong MASc students may apply to transfer to the PhD program after completing only one year of the MASc program.*

Program Requirements
- *At the beginning of each student's program, a professor in the department will be identified as the supervisor and will guide the student in the research program and selection of courses.*
- *Minimum departmental standards in coursework: completion of **3.5 full-course equivalents (FCEs) plus a thesis**.*
- *Participation in the non-credit seminar course JDE1000H during the first or second session of registration.*
- *In Years 1 and 2, students must attend at least 70% of seminars that are part of the MIE Seminar Series. Students who complete this requirement will receive credit for SRD4444Y MIE Seminar Series.*
- *Students must pass a qualifying examination, annual progress meetings, and the SGS Doctoral Final Oral Examination.*
- *Students must present a research seminar during the final year of their studies.*
- *Students must be on campus full-time unless special permission is obtained for off-campus study.*

- *Students in the PhD program have the option of completing an emphasis in Robotics or Sustainable Energy as part of their degree program. Please see details in the Mechanical and Industrial Engineering MASc, MEng, PhD Emphases section.*

Program Length
5 years

Time Limit
7 years

PhD Program (Direct-Entry)

Minimum Admission Requirements
- *Applicants are admitted under the General Regulations of the School of Graduate Studies. Applicants must also satisfy the Department of Mechanical and Industrial Engineering's additional admission requirements stated below.*
- *Admission to the PhD program is reserved for those who are able to present evidence of superior academic and research ability. Exceptionally strong applicants with a bachelor's degree and an appropriate background may apply directly to the PhD program and may be admitted via direct entry. Applicants are advised to consult with the Graduate Coordinator before applying to ensure that they have the appropriate admission requirements for direct entry.*

Program Requirements
- *At the beginning of each student's program, a professor in the department will be identified as the supervisor and will guide the student in the research program and selection of courses.*
- *Minimum departmental standards in coursework: completion of **3.5 full-course equivalents (FCEs) plus a thesis.***
- *Participation in the non-credit seminar course JDE1000H during the first or second session of registration.*
- *In Years 1 and 2, students must attend at least 70% of seminars that are part of the MIE Seminar Series. Students who complete this requirement will receive credit for SRD4444Y MIE Seminar Series.*
- *Students must pass a qualifying examination, annual progress meetings, and the SGS Doctoral Final Oral Examination.*
- *Students must present a research seminar during the final year of their studies.*
- *Students must be on campus full-time unless special permission is obtained for off-campus study.*
- *Students in the PhD program have the option of completing an emphasis in Robotics or Sustainable Energy as part of their degree program. Please see details in the Mechanical and Industrial Engineering MASc, MEng, PhD Emphases section.*

Program Length
5 years

Time Limit
7 years

PhD Program (Flexible-Time)

Minimum Admission Requirements
- *Applicants are admitted under the General Regulations of the School of Graduate Studies. Applicants must also satisfy the Department of Mechanical and Industrial Engineering's additional admission requirements stated below.*
- *Admission to a PhD program is reserved for those who are able to present evidence of superior academic and research ability. Students may be admitted to the PhD program with an appropriate University of Toronto master's degree or its equivalent from a recognized university with a minimum B+ average*
- *Applicants to the flexible-time PhD option are accepted under the same admission requirements as applicants to the full-time PhD option. However, in addition, applicants to the flexible-time PhD option must demonstrate that they are actively engaged in professional activities related to their proposed program of study.*

Program Requirements
- *At the beginning of each student's program, a professor in the department will be identified as the supervisor and will guide the student in the research program and selection of courses.*
- *Minimum departmental standards in coursework: completion of **2.5 full-course equivalents (FCEs) and a thesis**.*
- *Participation in the non-credit seminar course JDE1000H during their first or second session of registration.*
- *In Years 1 and 2, students must attend at least 70% of seminars that are part of the MIE Seminar Series. Students who complete this requirement will receive credit for SRD4444Y MIE Seminar Series. Students whose professional background is such that they would be deemed to have fulfilled this breadth requirement may be exempted upon consultation with the admissions committee.*
- *Students must pass a qualifying examination, annual progress meetings, and the SGS Doctoral Final Oral Examination.*
- *Students must present a research seminar during the final year of their studies.*
- *Students in the PhD program have the option of completing an emphasis in Robotics or Sustainable Energy as part of their degree program. Please see details in the Mechanical and Industrial Engineering MASc, MEng, PhD Emphases section.*

Program Length
6 years

Time Limit
8 years

MIE: Mechanical and Industrial Engineering MASc, MEng, PhD Emphases

Emphasis: Advanced Manufacturing (MEng only)
MEng students must successfully complete:

- *Four half courses (2.0 full-course equivalents [FCEs]), including at least one core course.*
- *Elective courses may include other core courses, and courses from either of two streams: Manufacturing Engineering and Manufacturing Management.*

Core Courses
AER501H *Advanced Mechanics of Structures*
AER1403H *Advanced Aerospace Structures*
APS1028H *Operations and Production Management for Manufacturing and Services*
CHE1123H *Liquid Biofuels*
MIE519H *Advanced Manufacturing Technologies*
MIE1740H *Smart Materials and Structures*.

Elective Courses — Manufacturing Engineering
AER521H, AER 1415H,
CHE575H, CHE1134H, CHE1475H,
MIE506H, MIE540H, MIE1706H, MIE1713H, MIE1718H, MIE1743H,
MSE1013H, MSE1015H, MSE1028H, MSE1031H, MSE1058H, MSE1061H,
ROB501H.

Elective Courses — Manufacturing Management
APS1005H, APS1012H, APS1013H, APS1017H, APS1020H, APS1023H, APS1040H,
APS1088H, APS1420H,
CHE561H, CHE1434H,
MIE523H, MIE1022H, MIE1505H, MIE1514H, MIE1715H, MIE1721H, MIE1723H,
MIE1727H,
TEP1011H, TEP1026H, TEP1501H.

Emphasis: Advanced Soft Materials (MEng only)
MEng students must successfully complete any **four half courses (2.0 full-course equivalents [FCEs])** from the following list:

CHE562H, CHE1310H, CHE1333H, CHE1335H, CHE1475H,
JTC1134H, JTC1135H,

MIE1705H, MIE1706H, MIE1707H, MIE1740H, MSE1032H.

Students may double-count one course at most towards any MIE emphasis, or towards any other emphasis in the Faculty.

Emphasis: Analytics (MEng only)

To be admitted to the emphasis in Analytics, MEng students must first successfully complete a **prerequisite course APS1070H (0.5 full-course equivalent [FCE])**.

Subsequently, to earn the emphasis, students must successfully complete **four additional half courses (2.0 FCEs)** from the list of core courses or elective courses. These must include at least one core course; the remaining courses must be selected from the list of elective courses.

Students must have completed the prerequisite course APS1070H before taking any of the core courses.

Prerequisite Course

APS1070H *Foundations of Data Analytics and Machine Learning*.

Core Courses

ECE1513H *Introduction to Machine Learning* (exclusions: CSC411H, CSC2515H, ECE421H, ECE521H, ECE1504H)
MIE1624H *Introduction to Data Science and Analytics*.

Elective Courses

APS502H, APS1005H, APS1017H, APS1022H, APS1040H, APS1050H, APS1051H, APS1052H, APS1080H,
CHE507H, CHE1108H, CHE1147H, CHE1148H, CHE1434H,
CIV1504H, CIV1506H, CIV1507H, CIV1532H, CIV1538H,
ECE537H, ECE1504H (exclusions: CSC411H, CSC2515H, ECE421H, ECE521H, ECE1513H),
ECE1505H, ECE1510H, ECE1657H, ECE1778H, ECE1779H,
MIE562H, MIE1413H, MIE1501H, MIE1512H, MIE1513H, MIE1517H, MIE1620H,
MIE1621H, MIE1622H, MIE1623H, MIE1628H, MIE1653H, MIE1721H, MIE1723H,
MIE1727H.

Emphasis: Biomanufacturing (MEng only)

MEng students must successfully complete any **four half courses (2.0 full-course equivalents [FCEs])** from the following list:

CHE1123H, CHE1125H, CHE1133H, CHE1134H, CHE1135H, CHE1334H, CHE1471H, JCC1313H,
JTC1331H,
BME1459H, BME1480H.

Students may double-count one course at most towards any MIE emphasis, or towards any other emphasis in the Faculty.

Emphasis: Engineering and Globalization (MEng only)

MEng students must successfully complete **four half courses (2.0 full-course equivalents [FCEs])** from the following lists, with at least two half courses (or one full course) taken from Group A.

Group A

APS510H, APS530H, APS1420H, JCR1000Y (full-year course).

Group B

APS1015H, APS1020H, APS1024H, CHL5700H, CIV1399H, JMG2020H.

Note: Students who choose to pursue an MEng project in their home department that aligns with the Centre for Global Engineering (CGEN)'s disciplinary focus, as deemed by the CGEN Director, may count the project as one required Group B course.

Students who complete the requirements of the emphasis in Engineering and Globalization and wish to obtain a notation on their transcript should contact the Faculty Graduate Studies office.

Emphasis: Entrepreneurship, Leadership, Innovation and Technology in Engineering (ELITE) (MEng only)

MEng students must successfully complete **any four of the following courses (2.0 full-course equivalents [FCEs])**:

Leadership

TEP1010H, TEP1011H, TEP1026H, TEP1027H, TEP1029H, TEP1030H, TEP1501H, TEP1502H, TEP1601H.

Entrepreneurship and Innovation
APS1012H, APS1013H, APS1015H, APS1023H, APS1033H, APS1035H, APS1036H, APS1041H, APS1061H, APS1088H.

Finance and Management
AER1601H, APS502H, APS1001H, APS1004H, APS1005H, APS1009H, APS1016H, APS1017H, APS1020H, APS1022H, APS1028H, APS1032H, APS1038H, APS1039H, APS1040H, APS1043H, APS1049H, APS1050H, APS1051H, APS1052H.

Engineering and Society
APS510H, APS1018H, APS1024H, APS1025H, APS1031H, APS1034H, APS1101H, APS1420H.

Emphasis: Forensic Engineering (MEng only)
MEng students must successfully complete **four courses (one core course and three elective courses)**.

Core Course
MSE1031H *Forensic Engineering*.

Elective Courses
AER1604H,
APS1034H, APS1039H, APS1040H, APS1101H,
BME1480H, BME1800H, BME1801H, BME1802H,
CHE561H, CHE568H, CHE1213H, CHE1431H, CHE1432H, CHE1434H, CHE1436H,
CIV510H, CIV518H, CIV1163H, CIV1171H, CIV1174H, CIV1190H, CIV1201H, CIV1279H,
CIV1282H, CIV1422H, CIV1429H,
JMB1050H,
JNC2503H,
MIE507H, MIE533H, MIE566H, MIE1301H, MIE1303H, MIE1411H, MIE1414H, MIE1616H,
MIE1708H, MIE1713H, MIE1714H, MIE1721H, MIE1723H, MIE1727H, MIE1804H,
MSE1015H, MSE1016H, MSE1022H, MSE1032H, MSE1067H.

Emphasis: Robotics (MASc, MEng, PhD)
Students must successfully complete **four courses (2.0 full-course equivalents [FCEs])** chosen from at least two of the following groups, and no more than two in any given group:

Group 1: Planning and Control
AER1516H, AER1517H,
ECE557H (exclusion: ECE410H), ECE1619H, ECE1635H, ECE1636H, ECE1647H, ECE1653H,

ECE1657H,
MIE1064H, MIE1068H.

Group 2: Perception and Learning
AER1513H, AER1515H,
CSC2503H, CSC2506H, CSC2515H, CSC2541H, CSC2548H,
ECE516H, ECE521H, ECE1511H, ECE1512H,
JEB1433H,
ROB501H.

Group 3: Modelling and Dynamics
AER1503H, AER1512H, AER506H,
JEB1444H,
MIE1001H.

Group 4: Systems Design and Integration
AER525H (exclusion: ECE470H), AER1216H, AER1217H,
CSC2621H,
ECE470H (exclusion: AER525H),
MIE505H, MIE506H, MIE1070H, MIE1075H, MIE1076H, MIE1080H, MIE1809H,
ROB521H, ROB1514H.

Emphasis: Sustainable Energy (MASc, MEng, PhD)
MASc and PhD students must successfully complete:

- At least **three half courses (1.5 full-course equivalents [FCEs])** *from either of the following lists below.*
- *A* **thesis** *towards their degree on a topic related to sustainable energy. Topics must be approved by the steering committee of the Institute of Sustainable Energy. Contact: Mandeep Rayat.*

MEng students must successfully complete:

- **Four half courses (2.0 FCEs)** *from either of the following lists below, including at least one core course (0.5 FCE).*

Core Courses
APS1032H *Introduction to Energy Project Management*
MIE515H *Alternative Energy Systems*
MIE1120H *Current Energy Infrastructure and Resources*.

Elective Courses
AER507H, AER1304H, AER1315H, AER1415H,
CHE568H, CHE1053H, CHE1118H, CHE1123H, CHE1142H, CHE1143H,

CIV575H, CIV576H, CIV577H, CIV1303H, CIV1307H,
ECE533H, ECE1030H, ECE1055H, ECE1057H, ECE1059H, ECE1085H, ECE1086H,
ECE1092H, ECE1094H, ECE1476H,
MIE516H, MIE517H, MIE1128H, MIE1129H, MIE1130H, MIE1240H, MIE1241H,
MIE1715H,
MSE1023H, MSE1028H, MSE1058H.

Students who complete the requirements of the emphasis in Sustainable Energy will receive a notation on their transcript from the Faculty Graduate Studies Office following a recommendation from the Institute of Sustainable Energy. Contact: Mandeep Rayat.

MIE: Mechanical and Industrial Engineering MASc, MEng, PhD Courses

See the departmental website for a schedule of available courses.

Fluid Mechanics

MIE520H	Biotransport Phenomena
MIE1201H	Advanced Fluid Mechanics I
MIE1206H	Non-Newtonian Fluid Mechanics
MIE1207H	Structure of Turbulent Flows
MIE1208H	Microfluidic Biosensors (prerequisite: undergraduate-level fluidic mechanics)
MIE1210H	Computational Fluid Mechanics and Heat Transfer
MIE1212H	Convective Heat Transfer
MIE1214H	Applied Computational Fluid Dynamics (CFD)
MIE1222H	Multiphase Flows
MIE1224H	Heating, Ventilating, and Air Conditioning (HVAC)
MIE1232H	Microfluidics and Laboratory-on-a-Chip Systems
MIE1240H	Wind Power
MIE1241H	Energy Management

MIE1299H	Special Topics in Fluid Mechanics

Human Factors and Ergonomics

MIE542H	Human Factors Integration
MIE1401H	Human Factors Engineering
MIE1402H	Experimental Methods in Human Factors Research
MIE1403H	Analytical Methods in Human Factors Research
MIE1411H	Design of Work Places
MIE1412H	Human-Automation Interaction
MIE1413H	Statistical Models in Empirical Research
MIE1414H	Human Factors in Transportation
MIE1415H	Analysis and Design of Cognitive Work
MIE1444H	Engineering for Psychologists

Information Engineering

JMG2020H	Big Data
MIE1501H	Knowledge Modelling and Management
MIE1505H	Enterprise Modelling
MIE1510H	Formal Techniques in Ontology Engineering
MIE1512H	Data Analytics
MIE1513H	Decision Support Systems
MIE1514H	Systems Design and Engineering: A Product Perspective
MIE1516H	Structured Learning and Inference
MIE1517H	Introduction to Deep Learning (prerequisite: APS1070H or equivalent)

Mechanics and Materials

MIE517H	Fuel Cell System
MIE540H	Product Design
MIE1128H	Materials for Clean Energy Technologies
MIE1301H	Solid Mechanics
MIE1303H	Fracture Mechanics
MIE1359H	Engineering Cell Biology and Micro-Nanoengineered Platforms
MIE1705H	Thermoplastics Polymer Processing
MIE1706H	Manufacturing of Cellular and Microcellular Polymers
MIE1707H	Structure-Property Relationships of Thermoplastic and Composite Foams
MIE1708H	Collision Reconstruction
MIE1713H	Analysis and Design of Joints in Manufactured Products
MIE1715H	Life Cycle Engineering
MIE1720H	Creativity in Conceptual Design
MIE1724H	Additive Manufacturing in Engineering Applications
MIE1725H	Soft Materials and Machines
MIE1732H	Tribology
MIE1740H	Smart Materials and Structures
MIE1742H	Composite Materials Design
MIE1743H	Axiomatic Design Principles for Conceptual and Embodiment Design
MIE1744H	Nanomechanics of Materials
MIE1804H	The Finite Element Method in Mechanical Engineering
MIE1807H	Principles of Measurements

Mechatronics and Dynamics

MIE506H	MEMS Design and Microfabrication
MIE1001H	Advanced Dynamics
MIE1005H	Theory of Vibrations
MIE1010H	Acoustics and Noise Control
MIE1064H	Control Analysis Methods with Applications to Robotics
MIE1068H	Applied Nonlinear Control
MIE1070H	Intelligent Robots for Society
MIE1075H	AI Applications in Robotics (prerequisites: control systems, robotics, AI fundamentals)
MIE1076H	AI Applications in Robotics II (prerequisites: MIE1075H, control Systems, robotics, AI fundamentals)
MIE1077H	AI Applications in Robotics III (prerequisites: robotics, MIE1075H, MIE1076H, or equivalent)
MIE1080H	Introduction to Healthcare Robotics
MIE1452H	Signal Processing for Bioengineering
MIE1453H	Introduction to Sensors and Sensor Network
MIE1718H	Computer Integrated Manufacturing
MIE1766H	Aluminum Die Casting 2. — Product Design and Optimization
MIE1767H	Mechatronics in Automotive Applications 1
MIE1768H	Mechatronics in Automotive Applications 2 (prerequisite: MIE1767H)
MIE1809H	Advanced Mechatronics

Operations Research

MIE561H	Healthcare Systems
MIE562H	Scheduling

MIE566H	Decision Analysis
MIE1603H	Integer Programming
MIE1605H	Stochastic Processes
MIE1607H	Stochastic Modelling and Optimization
MIE1612H	Stochastic Programming and Robust Optimization (prerequisites: MIE262, APS1005H, or equivalent; and MIE231, APS106, or equivalent)
MIE1613H	Stochastic Simulation
MIE1615H	Markov Decision Processes
MIE1616H	Research Topics in Healthcare Engineering
MIE1619H	Constraint Programming and Hybrid Algorithms
MIE1620H	Linear Programming and Network Flows
MIE1621H	Non-Linear Optimization
MIE1622H	Computational Finance and Risk Management
MIE1623H	Introduction to Healthcare Engineering
MIE1624H	Introduction to Data Science and Analytics
MIE1628H	Big Data Science
MIE1653H	Integer Programming Applications
MIE1699H	Special Topics in Operations Research
MIE1714H	Failure Analysis
MIE1721H	Reliability
MIE1723H	Engineering Asset Management
MIE1727H	Quality Assurance I

Thermal Sciences

MIE515H	Alternative Energy Systems

MIE516H	Combustion and Fuels
MIE1101H	Advanced Classical Thermodynamics
MIE1107H	Statistical Thermodynamics
MIE1115H	Heat Transfer with Phase Change
MIE1118H	Partially Ionized Gases
MIE1120H	Current Energy Infrastructure and Resources
MIE1122H	Combustion Engine Processes
MIE1123H	Fundamentals of Combustion
MIE1127H	Engineering Applications of Waves
MIE1129H	Nuclear Engineering I: Reactor Physics and the Nuclear Fuel Cycle
MIE1130H	Nuclear Engineering II: Thermal and Mechanical Design of Nuclear Power Reactors
MIE1132H	Heat Exchanger Design
MIE1133H	Laser Applications in Engineering
MIE1801H	Advanced Engineering Analysis

APS Engineering Courses

APS1005H	Operations Research for Engineering Management
APS1012H	Managing Business Innovation and Transformational Change
APS1013H	Applying Innovation in Engineering and Business Operations
APS1015H	Social Entrepreneurship
APS1016H	Financial Management for Engineers
APS1017H	Supply Chain Management and Logistics
APS1022H	Financial Engineering 2
APS1023H	New Product Innovation

APS1028H	Operations and Production Management for Manufacturing and Services
APS1032H	Introduction to Energy Project Management
APS1034H	Making Sense of Accidents
APS1043H	Writing Your Own Patent Application
APS1049H	Management Consulting for Engineers
APS1050H	Blockchain Technologies and Cryptocurrencies
APS1051H	Portfolio Management Praxis Under Real Market Constraint
APS1052H	Artificial Intelligence in Finance: From Neural Networks to Deep Learning
APS1061H	Business Strategy and Intrapreneurship
APS1070H	Foundations of Data Analytics and Machine Learning
APS1101H	System Dynamic Risk Assessment (recommended prerequisite: APS1034H)
APS1801H	Multidisciplinary MEng Project
APS1802Y	Multidisciplinary MEng Project
APS1803Y	Multidisciplinary MEng Project
APS2000Y	Summer Engineering Practicum (Credit/No Credit)
TEP1203H	Teaching Engineering in Higher Education
TEP1204H	Instructional Design in Engineering Education

SCFI MEng Courses

MIE1750H	Innovation Management I
MIE1751H	Innovation Management II
MIE1752H	Innovation Finance and Economics
MIE1753H	Legal Framework for Innovation
MIE1754H	Laser Applications in Manufacturing

MIE1755H	CAE Technologies in Automotive Engineering
MIE1757H	Electric Motor Technologies in Automotive Engineering
MIE1758H	Polymers and Composites in Automotive Design and Manufacturing
MIE1759H	Polymers and Composites Processing in Automotive
MIE1760H	Metals in Automotive Design and Manufacturing
MIE1761H	Metal Forming Simulation
MIE1762H	Centrifugal and Positive Displacement Pumps I
MIE1763H	Hot Stamping 1. — Metallurgy, Materials, Thermomechanical Treatment, and Welding
MIE1764H	Hot Stamping 2. — Process and Product Performance Simulation and Optimization
MIE1765H	Aluminum Die Casting 1. — Metallurgy, Process Design, and Optimization

Reading Courses

MIE2002H	Readings in Industrial Engineering I (Credit/ No Credit)
MIE2003H	Readings in Industrial Engineering II (Credit/No Credit)
MIE2004H	Readings in Mechanical Engineering I (Credit/No Credit)
MIE2005H	Readings in Mechanical Engineering II (Credit/No Credit)

Seminar Courses

SRM3333Y	MIE Seminar Series for MASc Students
SRD4444Y	MIE Seminar Series for PhD Students

Project

MIE8888Y	MEng Research Project

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