UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

# Meeting of Faculty Council

**December 18, 2024 | 12:10-2:00 pm**
**Hybrid (GB202 & Zoom)**

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## AGENDA

| Item | | Presenter |
|---|---|---|
| 1. | **Speaker's Welcome and Approval of Agenda**<br>Agenda to approve as a regular motion | J Nogami |
| 2. | **Introduction of New Faculty**<br>Samin Aref (MIE), Daifei Zhang (ECE) | Chairs & Directors |
| 3. | **Adoption of Minutes of Previous Meeting**<br>For approval as a regular motion | J Nogami |
| 4. | **Report of the Dean** | C Yip |
| 5. | **Study Break and Winter Reading Week Regulations** (Report 3767R)<br>For approval as a regular motion | E Young |
| 6. | **Major Curriculum Changes, 2025-2026** (Report 3777R)<br>For approval as a regular motion | E Young |
| 7. | **Information Reports**<br>To receive for information | |
| | a) **Inclusion of Certificates in the University of Toronto Sustainability Scholar Program** (Report 3772) | D Aleman |
| | b) **Admissions Cycle 2024** (Report 3774) | A Chong |
| | c) **Pilot of Chemistry Requirement Change for A-Level Applications** (Report 3775) | A Chong |
| | d) **Engineering Graduate Education Committee Update** (Report 3776) | L Romkey |
| | e) **Formalization of "Magic File" to Conditional Decision Regulation** (Report 3778) | V Papangelakis |

| | | |
|---|---|---|
| **8.** | **Other Business** | J Nogami |
| **9.** | **Graduate Diploma in Engineering Leadership**<br>Discussion Item | L Romkey |
| **10.** | **Date of Next Meeting** | J Nogami |
| **11.** | **Adjournment** | J Nogami |

11/26/2024 3:22 PM

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

# Council of the Faculty of Applied Science & Engineering
# Minutes of the Meeting of October 24, 2024

**MEMBERS:** Mark Bussman (Speaker), Chris Yip (Dean), Adam Abreha, Grant Allen, Justin Beland, Evan Bentz, Raymond Bhushan, Helen Bright, Trevor Carey, Abigail Cave, Alan Chong, Shair Cohen, Liyang Day Hattrick, Oluwatobi Edun, Natalie Enright Jerger, Greg Evans, Evelyn Fallah, Jennifer Farmer, Diane Giang, Omer Gulder, Marianne Hatzopoulou, Angela Henshilwood, Jane Howe, Anthony Bowman, Tulgar Ilhan, Kat Jia, Dawn Kilkenny, Inho Kim, Don Kirk, Deepa Kundur, Ethan Mao, Katherine Mezei, Jonathan Rocheleau, Lisa Romkey, Tess Seip

**SECRETARIAT**: Caroline Ziegler (Secretary), Alex Schroen (Moderator), Silvia Delgado (Governance Administrative Assistant)

**GUESTS:** Rodney Gensell, Devin Gobson, Rocky Petinakis, Zeeshan Rayees, Frank Scornaienchi, Alex Tichine, Alistair Vaz, Nefeteria Wickham

## 1. Speaker's Welcome and Approval of Agenda

Acting Speaker Markus Bussman called the first Faculty Council meeting of 2024-2025 to order at 12:10 pm, welcoming new Council members in GB202 and online.

The Speaker acknowledged the land on which the University of Toronto operates, reviewed protocols for the hybrid meeting and encouraged members to review the orientation slides on the Faculty Council webpage.

The agenda and reports were distributed on October 11. There was no discussion and on a regular motion duly moved, seconded and carried, the agenda was approved.

## 2. Introduction of New Faculty Members

New faculty members Benjamin Sanchez of the Department of Chemical Engineering & Applied Chemistry; Trevor Carey of the Department of Civil & Mineral Engineering; Fiona Coll of the Institute for Studies in Transdisciplinary Engineering Education and Practice; Nicholas Rhinehart of the University of Toronto Institute for Aerospace Studies; Liyang Dai-Hattrick of the Department of Materials Science & Engineering; and Justin Beland of the Department of Mechanical & Industrial Engineering, were introduced by their respective chairs and directors.

## 3. Adoption of the Minutes of Previous Meetings

No errors or omissions were noted in the minutes of the April 15, 2024 Council meeting and on a regular motion duly moved, seconded and carried, the minutes were approved.

## 4. Memorial Tributes

### a) Keigo Iizuka

Deepa Kundur, chair of The Edward S. Rogers Sr. Department of Electrical & Computer Engineering, read the following memorial tribute in honour of Professor Emeritus Keigo Iizuka.

Be it resolved –

> THAT the Council of the Faculty of Applied Science & Engineering record with deep regret the death on June 4, 2024 of Professor Emeritus Keigo Iizuka.

Professor Keigo Iizuka was born in Kobe, Japan, on August 29, 1931, into modest means. He learned early on the importance of perseverance and diligence and dedicated himself to his studies.

Keigo completed his undergraduate studies at Kyoto University, where he held a prestigious scholarship before pursuing a PhD in Applied Physics at Harvard University on a Fulbright scholarship, graduating in 1961. Following his doctoral studies, he served as a Research Fellow and later as a Lecturer at Harvard. He joined the University of Toronto's then-named Department of Electrical Engineering in 1968, where he would make a significant name for himself.

Over his many years with ECE, Keigo explored a broad spectrum of areas, from antennas and microwave holography to optical measurement, sensor technology, fibre optics, and 3D displays. He authored a number of impactful publications including three significant books on photonics and engineering optics. Among his most notable achievements was the invention of the "Omni-focus Video Camera," which solved the fundamental challenge of achieving equal focus for elements in both the background and foreground of an image. This innovation integrated an array of colour video cameras with different focal distances and a unique distance mapping technique that allowed for perfect clarity across the entire field of view, a remarkable feat in the field of optics.

Keigo received the Fujio Frontier Award and the ATR Excellence Research Award for his research, and he was named a Fellow of the Optical Society of America. Keigo's dedication to teaching left an indelible mark on generations of students. Professor Li Qian, once his student and later his colleague, recalled her experience in his Optical Communication course as "exhilarating and eye-opening." She shared that while the course started with engaging videos and demonstrations, it soon transitioned into rigorous mathematical challenges, teaching students the balance between fascination and discipline that defined optics. "He lightened our hearts even as he

lightened our coursework," Li noted, reflecting on Keigo's ability to combine humour, creativity, and deep technical insight.

Beyond his impact in the classroom, Keigo was recognized for his resourcefulness and continued passion for research even after his retirement. Despite limited funding, he remained active, often developing ingenious experiments with simple materials, such as using a compact disc as a spectrometer. Professor Al Leon-Garcia described him as "always cheerful… and busy," recalling how the fourth floor of the Sandford Fleming Building was often a hub of activity around his experiments.

Professor Micah Stickel, a former student, remembered Keigo's "effortless enthusiasm" and the joy he brought to his teaching. He noted that his "Fundamentals of Optics" course was enriched with hand-drawn cartoons that helped students understand complex ideas. Professor George Eleftheriades described his Engineering Optics textbook as "full of insight and practical wisdom – a treasure to have."

Beyond academia, Keigo was a multi-talented individual with passions that extended to his family, dance, and creative writing. Professor Khoman Phang fondly recalled seeing him on Friday nights at the Ballroom Dance Club, a reminder of how much more there was to him than his academic achievements. Keigo even co-authored a children's book, "Kuro," with his daughters, a testament to his creativity and dedication to his family.

Professor Keigo Iizuka's legacy will undoubtedly live on through his research and teaching. However, Keigo taught us that the most significant impact you can have is how you treat others. His gentle mentorship of students, his kind friendship and collaboration with colleagues, and his inspiring way of seeing the world have positively impacted all who knew him. It is not lost on us, then, that Keigo's research involved bringing multiple things to focus!

Keigo is survived by his daughters Nozomi, Izumi, Megumi, and Ayumi, who lovingly cared for him throughout his life and in his final years.

Be it further resolved –

> THAT this tribute to Professor Emeritus Keigo Iizuka be inscribed in the minutes of this Council meeting, and that copies be sent to his family as an expression of the respect and gratitude of the members of this Council.

**b) Kenneth Selby**

Marianne Hatzopoulou, chair of the Department of Civil & Mineral Engineering, read the following memorial tribute in honour of Professor Emeritus Kenneth A. Selby.

Be it resolved –

> THAT the Council of the Faculty of Applied Science & Engineering record with deep regret the death on August 15, 2024 of Professor Emeritus Kenneth Selby.

Professor Selby was an accomplished scholar, holding a Bachelor of Civil Engineering and an MBA from the University of Toronto, and a PhD in Civil Engineering from the University of Illinois.

Professor Selby joined the faculty of the University of Toronto as an Assistant Professor in 1964, was promoted to Associate Professor in 1967 and full professor in 1988. Since 1997, he has been Professor Emeritus. He supervised numerous undergraduate, masters and doctoral students over this time and taught construction-related courses. Well-known for his enthusiasm, creativity and positive disposition, he was voted “Professor of the Year” in Civil Engineering several times by his students. In 1992 he received a University-wide award for excellence in teaching in the professional faculties (sciences) from the Association of Part-time Undergraduate Students and the Students’ Administrative Council. From 1994 to 1996, Professor Selby represented Civil Engineering and Geological Engineering on the UTFA council. He dedicated his career to education and had a passion for teaching and mentoring young minds. In the 1980s, when student employment was hard to find, he formed Ken Selby and Associates providing students with opportunities in the construction industry.

In 1973 Professor Selby, along with Professor Emeritus John Timusk, launched U of T’s first concrete canoe in Toronto Harbour, marking the beginning of the popular student club. The use of a popular breakfast cereal in the initial concrete mix allowed for the watercraft to float – the cereal was later replaced with a manufactured product.

Ken had a lifelong passion for and excelled in many sports, including swimming, football, hockey, downhill skiing, and tennis, among others. He coached numerous youth sports, particularly hockey, and supported his children and grandchildren in their activities. In the '60s, he built his family a tennis court at the cottage and later in his life you could often find him on the tennis courts at the Toronto Cricket Club, participating in many leagues, well into his 80s.

He enjoyed following news, politics, and world affairs, and was a particular champion of women and girls in all their pursuits. His last summer was spent in Muskoka, surrounded by loved ones, marking 90 consecutive summers spent in his happy place, where he has created a wonderful family legacy. Ken's kindness, intellect, enduring love for his family, and support of his friends will be remembered and celebrated by all who knew him.

Professor Selby is survived by his wife of 66 years, Anne; three children and seven grandchildren. He was predeceased in 2007 by his daughter Pam.

Be it further resolved –

> THAT this tribute to Professor Emeritus Kenneth Selby be inscribed in the minutes of this Council meeting, and that copies be sent to his family as an expression of the respect and gratitude of the members of this Council.

The Speaker assumed concurrence with these resolutions and Council observed one minute of silence in honour of Professors Emeriti Iizuka and Selby.

## 5. Report of the Dean

Dean Chris Yip welcomed all to Council and acknowledged new chairs and directors, namely Evan Bentz, Vice-Dean Undergraduate; Hani Naguib, chair of Materials Science & Engineering; and Deepa Kundur, reappointed chair of Electrical & Computer Engineering. He thanked them for serving in their roles and looks forward to their leadership.

### a) Recruitment and Admissions

The Faculty's incoming class remains strong with an average of 95%, similar to last year, and 39% women. Domestic enrollment exceeded expectations due to an increase in applications and a higher yield. However, despite a rise in international applications and strong acceptance rates, the yield from international students dropped, causing the Faculty to miss its international enrollment target.

### b) Accreditation

The CEAB accreditation visit is scheduled to take place in 2025-2026.

### c) External Reviews

The 2024-2025 external reviews are scheduled as follows: UTIAS in January or February, ECE in April and ISTEP in May.

### d) Graduation Breakfast and Convocation

The Graduation Breakfast and Convocation are scheduled for Thursday, October 31. The Graduation Breakfast, hosted by Advancement, will take place from 7:30 to 9:30 am at the Faculty Club. Convocation will follow from 10:00 to 11:30 am at Convocation Hall, where degrees will be conferred, including Doctor of Philosophy, Master of Applied Science, Master of Engineering, and various other specialized master's and bachelor's degrees.

### e) Annual Report

The By the Numbers 2024 and Impact Report 2024: Bold Solutions for a Better World are now available on the FASE website. All members are encouraged to review them when possible.

The Speaker thanked the Dean for his report. There was no discussion.

## 6. Information Reports

The following reports were approved by the Executive Committee of Faculty Council at its October 4 meeting and are being presented for Council's information.

### a) Annual Report of the Academic Appeals Board (Undergraduate)

Don Kirk, chair of the Academic Appeals Board (Undergraduate), presented Report 3970, a summary of appeals and dispositions for the 2023-2024 academic year, and commented on updates, trends, and observations within the academic appeals.

The report was received for information.

### b) Teaching Methods & Resources Committee 2023-2024 Activity Report and 2024-2025 Goals

David Steinman, chair of the Teaching Methods & Resources Committee, presented Report 3768, a summary of the activities undertaken by the committee during the 2023-2024 academic year. The report also references committee goals for 2024-2025, based on the outcomes of these activities.

A question was raised about the focus of the first working group, specifically regarding the Annual Activity Report, and whether it primarily addresses teaching for both tenure-stream and teaching-stream faculty. It was clarified that the group is focusing on the teaching section of the report, particularly the narrative summaries, and aims to provide clearer guidance for faculty across departments.

A suggestion was made to develop separate activity report guidelines for teaching stream and research stream faculty, as some departments already distinguish between the two. This was noted as a consideration for the working group to explore further.

The report was received for information.

### c) Standing Committee and Academic Appeals Board (Undergraduate) Appointments, 2024-2025

The Speaker presented Report 3769, membership lists for the Academic Appeals Board (Undergraduate) and the eight standing committees of Council for the current academic year. These lists are posted on the Faculty Council webpage and updated as required.

### d) Annual Report of the Engineering Alumni Network Awards Committee

Liane Catalfo, president of the Engineering Alumni Network, presented Report 3971, recommendations for the 2024 Distinguished Alumni Award, Malcom McGrath Service Award, Research & Innovation Award, and the Rising Star Award.

## 7. Other Business

The Iron Ring Ceremony is confirmed for Saturday, March 15 at 10:00 am, marking the 100th anniversary of Camp One Iron Ring. An alternate date, March 6, is available for those who request it. Those who have their PEng designation but do not have an Iron Ring are welcome to receive one and can contact Chirag Variawa for arrangements. The ceremony will be held at the Metro Toronto Convention Centre.

## 8. Engineering Science Major in Transportation Systems Engineering

Marianne Hatzopoulou, chair of the Department of Civil & Mineral Engineering, and Natalie Enright Jerger, director of the Division of Engineering Science, presented on a proposed major in Transportation Systems Engineering for discussion and feedback.

The proposed major is set to launch in September 2025, with a focus on transportation and energy electives. There are no immediate plans to phase out the Energy Systems Engineering major, but efforts are underway to enhance and market the program more effectively. Industry consultations, including alumni feedback, have been crucial in shaping the curriculum. The target for the program is 30-35 students, with a smaller cohort considered unfeasible.

Concerns were raised about the program's alignment with other Core 8 disciplines, particularly industrial engineering and civil engineering, but the unique structure of EngSci which offers a two-year specialization is seen as a strength.

Questions were raised about how the program will be marketed to first- and second-year EngSci students, with alumni involvement seen as a key strategy. There is also interest in potential pathways for students to transfer into the major later on, though this is not expected to be a common occurrence. Some discussion centered around the overlap with graduate-level transportation courses and the unique programming that the EngSci model offers.

The proposal will be presented to the Undergraduate Curriculum Committee (UCC) on December 10 for approval and will be voted on at the Faculty Council meeting in February. New courses are expected to be introduced in September 2025 but will require regular UCC and governance approval before proceeding.

## 9. Date of Next Meeting

The next Faculty Council meeting is on December 18, 2024.

## 10. Adjournment

The meeting was adjourned at 2:00 pm.

/sd

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

**Report No. 3767 Revised**

# MEMORANDUM

**To:** Executive Committee of Faculty Council (November 19, 2024)
Faculty Council (December 18, 2024)

**From:** Professor Edmond Young
Chair, Undergraduate Curriculum Committee

**Date:** November 8, 2024

**Re:** **Fall Study Break and Winter Reading Week regulations**

## REPORT CLASSIFICATION

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

## BACKGROUND

In 2020, the Undergraduate Curriculum Committee (UCC) proposed, and Council approved, a Fall Study Break (Report No. 3649), matching the already-extant Winter Reading Week. While there are no classes during these breaks, it was discovered that there are no Faculty-wide regulations against work during Fall Study Break nor Winter Reading Week; it is instead merely a matter of common practice to avoid scheduling it then. While individual Departments have internal rules on the matter, the Faculty as a whole is in need of common regulations. This proposal seeks to remedy that gap.

In recognition of the desire not to remove two weekends from the assessment cycle, only the weekend following each break is included in the prohibition on assessments during these weeks.

## PROPOSED

A sample calendar entry for the Fall Study Break for the 2024-2025 term onwards is shown below, using dates from the Fall 2024 Study Break.

| Date | Activity |
|---|---|
| October 28 to November 1 | Fall Study Break: No lectures, tutorials, or practicals. |
| October 28 to November 3 | Fall Study Break: No assignments or assessments may be made due in Engineering courses* |

A sample calendar entry for the Winter Reading Week for the 2024-2025 term onwards is shown below, using dates from the Winter 2025 Reading Week.

| Date | Activity |
|---|---|
| February 17 | Family Day holiday; University closed |
| February 17 to February 21 | Winter Study Break: No lectures, tutorials, or practicals. |
| **February 17 to February 23** | Winter Study Break: No assignments or assessments may be made due in Engineering courses* |

*See Academic Regulations, Definitions of Terms [a link will be made to the updated calendar entry]

In addition to the update to sessional dates, an addition is proposed to the Definition of the calendar:

*Study Break: A week during the fall and winter terms when no lectures, tutorials, or practicals may be scheduled. In Engineering courses, no assessments may be scheduled nor assignments made due between Monday and the following Sunday of the study break week, inclusive of those dates. This does not prevent the Faculty from scheduling deferred exams during the break. Accommodations made by an instructor to an individual student as the result of a term-work petition are also allowed during these days.*

**CONSULTATION PROCESS**

These changes have been reviewed and approved by the UCC, which is comprised of representatives from each undergraduate program; the Vice-Dean, Undergraduate; the Vice-Dean, First Year; the Associate Dean, Cross-Disciplinary Programs; the Director, First Year Curriculum; the Registrar's Office; undergraduate students; the Faculty's Teaching and Learning Specialist; the Faculty's Scheduling Officer; and representatives from IBBME, UTIAS, the Engineering Communication Program, and the Engineering and Computer Science Library. The changes have also been reviewed and approved by the Undergraduate Assessment Committee and by the Registrar's Office.

**RECOMMENDATION FOR COUNCIL**

THAT the Fall Study Break and Winter Reading Week regulations as described in Report 3767 Revised be approved effective immediately.

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

**Report No. 3777 Revised**

# MEMORANDUM

**To:** Executive Committee of Faculty Council (November 19, 2024)
Faculty Council (December 18, 2024)

**From:** Professor Edmond Young
Chair, Undergraduate Curriculum Committee

**Date:** November 14, 2024

**Re: Major Curriculum Changes for the 2025-2026 Academic Year**

## 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

The Undergraduate Curriculum Committee is tasked with managing the curriculum change process for the Faculty.

## PROPOSED

This report summarizes course changes proposed for the 2025-2026 academic year.

## CONSULTATION PROCESS

These changes have been reviewed and approved by the Undergraduate Curriculum Committee, which is comprised of teaching staff representatives from the Faculty's departments and institutes; undergraduate student representatives; the Vice-Dean, Undergraduate; the Vice- Dean, First Year; the Director, First Year Curriculum; the Associate Dean, Cross-Disciplinary Programs; the Assistant Dean and Director, Diversity, Inclusion and Professionalism; and the Faculty Registrar. The Committee meets regularly to review and approve proposed changes to the undergraduate curriculum. The impact of these changes on students in the relevant programs has been considered.

## RECOMMENDATION FOR COUNCIL

THAT the proposed curriculum changes for the 2025-2026 academic year, as described in Report 3777, be approved.

# PROPOSED CURRICULUM CHANGES FOR 2025-2026

## 1. CHEMICAL ENGINEERING & APPLIED CHEMISTRY

### 1.1. Update pre-requisites for CHE204H1F

CURRENT Pre-requisite: APS110, CHE112

PROPOSED Pre-requisite: CHE112
PROPOSED Co-requisite: CHE220

- *APS110 removed as it is not required for student to succeed*
- *CHE220 added as corequisite course; labs focus on content discussed in CHE220; important for student to know theoretical knowledge of what's being done in lab*

### 1.2. Update pre-requisites for CHE205H1S

CURRENT Pre-requisite: CHE204

PROPOSED New co-requisite: CHE213

- *CHE213 added as corequisite course; labs focus on content discussed in CHE213; important for student to know theoretical knowledge of what's being done in lab*

### 1.3. Update pre-requisites for CHE213H1S

CURRENT Pre-requisite: APS110, CHE112

PROPOSED Pre-requisite: CHE112

- *APS110 removed as it is not required for student to succeed*

### 1.4. Update pre-requisites for CHE222H1S

CURRENT Pre-requisite: CHE208, CHE221, MAT188

PROPOSED Pre-requisite: APS105/APS106, MAT188, CHE208, CHE221

- *APS105H1/APS106H1 is crucial for success in CHE222*

### 1.5. Update pre-requisites for CHE230H1S

CURRENT Pre-requisite: CHE112

PROPOSED new co-requisite: CHE213

- *Add CHE213H1S as corequisite course as it helps reinforce concepts taught in CHE230*

**1.6. Update pre-requisites for CHE305H1S**

CURRENT Pre-requisite: CHE304, CHE323, CHE324, CHE332

PROPOSED Pre-requisite: CHE304, CHE323, CHE332

- *Remove CHE324 to avoid redundancy w/ CHE304 pre-requisites.*

**1.7. Update pre-requisites for CHE322H1S**

CURRENT Pre-requisite: APS106, CHE222

PROPOSED Pre-requisite: CHE222

- *Remove APS106H1 to avoid redundancy with CHE222*

**1.8. Update pre-requisites for CHE334H1S**

CURRENT Pre-requisite: CHE249, CHE324, CHE332

PROPOSED Pre-requisite: CHE324, CHE332, APS111, APS112

- *Remove CHE249 as CHE324 reviews all foundation taught in CHE249*
- *Add APS111, APS112 (avoids students in Y4 taking 4th year design + 1st year design at the same time)*

**1.9. Update pre-requisites for CHE430Y1F**

CURRENT Pre-requisite: CHE249, CHE324, two of: CHE311, CHE322, CHE333 (or equivalent)
PROPOSED Pre-requisite: CHE249, CHE334, Two of: CHE311, CHE322, CHE333 (or equivalent)

- *Remove CHE324. Add CHE334.*

**1.10. Change the accreditation unit (AU) distributions for CHE334**

CURRENT AU distribution: 50% ED, 50% CS

PROPOSED AU distribution: 70% ED, 10% ES, and 20% CS

- *Based on the current learning objectives and rubrics, the course can be weighted with more ED% and less CS%. (Additional departmental documentation available).*

**1.11. Update the Graduate Attributes for the following courses:**

- *The proposed GAs in the 2024 GAs and IDA level column are new changes.*

| Course Code | 2018 GAs | 2024 GAs and IDA Level | Reasoning |
|---|---|---|---|
| CHE204-CHE Lab I | N/A | 2.Problem Analysis - I | GA(s) now associated with the course |
| CHE205-CHE LAB II | N/A | 2. Problem Analysis - D<br>3.Investigation-D<br>7.Communication-D | GA(s) now associated with the course |
| CHE304-CHE LAB III | N/A | 5. Use of Engineering Tools-I | GA(s) now associated with the course |
| CHE305 -CHE LAB IV | N/A | 3. Investigation - D<br>5. Use of Engineering Tools -I<br>7. Communication Skills-D<br>8.Professional -D | GA(s) now associated with the course |
| CHE230-Environmental Chemistry | 2. Problem Analysis<br>3.Investigation<br>4.Design<br>7.Communication<br>9.Impact on Society and Environment<br>12.Lifelong learning | 3.Investigation-D<br>9.Impact on Society and Environment -D | Assessments have changed from 2018; updated to reflect new rubrics and Learning Objectives |
| CHE299H1-Communication | Under CHE298: 7. Communication | 7. Communication Skills-D | New course since 2018 cycle; GA now associated with course |
| CHE324H1-Process Design | 1.Knowledge Base<br>5.Use of Engineering tools<br>9. Impact on Society and Environment | 1.Knowledge Base-D<br>11. Economics & Project Management - D | Updated to reflect new Learning Objectives and rubric since 2018 cycle |
| CHE333H1-Chemical Reaction Engineering | 1.Knowledge Base<br>2.Problem Analysis<br>4.Design<br>5. Use of Engineering tools | 1.Knowledge Base-A<br>2. Problem Analysis-D<br>4.Design -D | Updated to reflect new Learning Objectives and rubric since 2018 cycle |
| CHE399H1- Professional Engineering Consultancy | Under CHE298: 7. Communication | 2. Problem Analysis-D<br>3.Investigation-D<br>7. Communication Skills-D<br>8.Professionalism-D<br>9.Impact on Society & | New course introduced since 2018 cycle; GAs now associated with the course |

| Course Code | 2018 GAs | 2024 GAs and IDA Level | Reasoning |
|---|---|---|---|
| | | Environment-D<br>11. Economics & Project management-D<br>12.Lifelong learning-D | |
| CHE430H1-Chemical Plant Design | 1.Knowledge Base<br>2.Problem Analysis<br>3.Investigation<br>4.Design<br>5. Use of Engineering Tools<br>6.Individual and Team Work<br>7.Communication Skills<br>8. Professionalism<br>9. Impact on Society & Environment<br>10. Ethics and Equity<br>11.Economics & project management<br>12. Lifelong learning | 1.Knowledge Base -A<br>2.Problem Analysis-A<br>3.Investigation-A<br>4.Design-A<br>5. Use of Engineering Tools-A<br>6.Individual and Team Work-A<br>7.Communication Skills-A<br>9. Impact on Society & Environment - A<br>11.Economics & project management - A | Updated to reflect new Learning Objectives and rubric since 2018 cycle |

## 1.12. Update the Academic Calendar with two new Tables of Technical Electives

PROPOSED Tables for Technical Electives:

- *Table 1 would show our **pre-approved technical electives.***
- *Table 2 (TE substitutes) would show the other courses that we have identified as technical but have fewer than 10 AU in ES+ED.*
- *A blurb would go after/under Table 1 and would therefore sit in between the two tables:*

**Table 1: Pre-approved Technical Electives**

| **Courses Offered in the Fall** | | **Lecture** | **Lab** | **Tutorial** | **Weight** |
|---|---|---|---|---|---|
| APS360H1: Applied Fundamentals | F/S | 3 | 1 | | 0.50 |
| APS502H1: Financial Engineering | F/S | 3 | | | 0.50 |
| BME440H1: Biomedical Engineering Technology and Investigation | F | 2 | 4 | | 0.50 |
| BME455H1: Cellular and Molecular Bioengineering II | F | 3 | 1.5 | 1 | 0.5 |
| BME595H1: Medical Imaging | F | 2 | 3 | 3 | 0.5 |
| CHE441: Engineering Materials | F | 3 | | 1 | 0.50 |
| CHE451H1: Petroleum Processing | F | 3 | | | 0.50 |
| CHE467H1: Environmental Engineering | F | 3 | | 1 | 0.50 |
| CHE507H1: Data-based Modelling for Prediction and Control | F | 3 | | 1 | 0.50 |
| CHE562H1: Applied Chemistry IV – Applied Polymer Chemistry, Science and Engineering | F | 3 | | | 0.50 |
| CHE565H1: Aqueous Process Engineering | F | 3 | | 1 | 0.50 |
| CHE566H1: Elements of Nuclear Engineering | F | 3 | | 2 | 0.50 |
| CIV220H1: Urban Engineering Ecology | F | 2 | 2 | | 0.50 |
| CIV300H1: Terrestrial Energy Systems | F/S | 3 | | 2 | 0.50 |
| CIV375H1: Building Science | F | 3 | 0.33 | 2 | 0.50 |
| CIV531H1: Transport Planning | F | 3 | | 1 | 0.50 |
| CIV550H1: Water Resources Engineering | F | 3 | | 2 | 0.50 |
| CME549H1: Groundwater Flow and Contamination | F | 3 | | 1 | 0.50 |
| ECE345H1: Algorithms and Data Structures | F/S | 3 | | 2 | 0.50 |
| ECE421H1: Introduction to Machine Learning | F/S | 3 | | 2 | 0.50 |
| ECE446H1: Sensory Communication | F | 3 | 1.5 | 1 | 0.50 |
| MIE515H1: Alternative Energy Systems | F | 3 | | 1 | 0.50 |
| MIE516H1: Combustion and Fuels | F | 3 | | 1 | 0.50 |
| MSE440H1: Emerging Applications in Biomaterials | F | 3 | | 1 | 0.50 |
| **Courses offered in Winter** | | **Lecture** | **Lab** | **Tutorial** | **Weight** |
| BME330H1: Patents in Biology and Medical Devices | S | 3 | | | 0.50 |
| BME331H1: Physiological Control Systems | S | 3 | 1 | 1 | 0.50 |
| BME412H1: Introduction to Biomolecular Engineering | S | 3 | | | 0.50 |
| BME530H1: Human Whole-Body Biomechanics | S | 2 | 2 | | 0.50 |
| CHE354H1: Cellular and Molecular Biology | S | 3 | 1 | 2 | 0.50 |
| CHE412H1: Advanced Reactor Design | S | 3 | | 1 | 0.50 |
| CHE450H1: Bioengineering Technology and Design | S | 3 | 0.66 | 1 | 0.50 |
| CHE460H1: Environmental Pathways and Impact Assessment | S | 3 | | 2 | 0.50 |
| CHE462H1: Food Engineering | S | 3 | | 1 | 0.50 |

| Courses Offered in the Fall | | Lecture | Lab | Tutorial | Weight |
|---|---|---|---|---|---|
| CHE469H1: Fuel Cells and Electrochemical Conversion Devices | S | 3 | | 1 | 0.50 |
| CHE471H1: Modelling in Biological and Chemical Systems | S | 3 | | 1 | 0.50 |
| CHE475H1: Biocomposites: Mechanics and Bioinspiration | S | 3 | | 1 | 0.50 |
| CHE561H1: Risk Based Safety Management | S | 3 | | 1 | 0.50 |
| CHE564H1: Pulp and Paper Processes | S | 3 | | 1 | 0.50 |
| CHE568H1: Nuclear Engineering | S | 3 | | 1 | 0.50 |
| CIV250H1: Hydraulics and Hydrology | S | 3 | 1.5 | 1 | 0.50 |
| CIV440H1: Environmental Impact and Risk Assessment | S | 3 | | 1 | 0.50 |
| ECE368H1: Probabilistic Reasoning | S | 3 | | 1 | 0.50 |
| FOR424H1: Innovation and Manufacturing of Sustainable Materials | S | 2 | | 1 | 0.50 |
| FOR425H1: Bioenergy and Biorefinery Technology | S | 2 | | 2 | 0.50 |
| MIE304H1: Introduction to Quality Control | S | 3 | 1 | 2 | 0.50 |
| MIE408H1: Thermal and Machine Design of Nuclear Power Reactors | S | 3 | | 2 | 0.50 |
| MIE517: Fuel Cell Systems | S | 3 | | 1 | 0.50 |
| MIE519H1: Advanced Manufacturing Technologies | S | 3 | | | 0.50 |
| MSE438H1: Computational Materials Design | S | 2 | 2 | 1 | 0.50 |
| MSE458H1: Nanotechnology in Alternate Energy Systems | S | 3 | | 2 | 0.50 |

- *ADD the following text between the tables*

Chemical Engineering students must complete 6 technical electives as part of their degree requirements. A minimum of 4 technical electives must come from Table 1: Pre-Approved Technical Electives. A maximum of 2 technical electives may come from Table 2: Technical Elective Substitutes.

If you would like to submit a course not listed in either table for technical elective consideration, please contact your Academic Advisor at ugrad.chemeng@utoronto.ca. Failure to obtain permission to take course that is not listed may result in unfulfilled degree requirements.

**Table 2: Technical Elective Substitutes**

| Course Code | | Lecture | Lab | Tutorial | Weight |
|---|---|---|---|---|---|
| CHE353H1: Engineering Biology | F | 2 | | 2 | 0.50 |
| CHM416: Separation Science | F | 2 | | | 0.50 |
| CHM457H1: Polymer Chemistry | F | 2 | | 1 | 0.50 |
| IMM250H1: The Immune Systems and Infectious Disease | F/S | 2 | | | 0.50 |
| MGY377H1: Microbiology I: Bacteria | F | 3 | | | 0.50 |
| PCL302H1: Pharmacodynamic Principles | F | 3 | | | 0.50 |
| PSL300H1: Human Physiology I | F | 3 | | 1A | 0.50 |
| CHM415H1: Topics in Atmospheric Chemistry | S | 2 | | | 0.50 |
| CHM456H1: Organic Materials Chemistry | S | 2 | | | 0.50 |
| FOR310H1: Bioenergy from Sustainable Forest Management | S | 2 | | 1 | 0.50 |
| HMB201H1: Introduction to Fundamental Genetics and its Applications | S | 2 | | 1 | 0.50 |
| PCL201H1: Introduction to Pharmacology and Pharmacokinetic Principles | S | 3 | | 1A | 0.50 |

## 2. ELECTRICAL & COMPUTER ENGINEERING

### 2.1. Change program offerings

2.1.1. ADD CSC384H1 F/S – Introduction to Artificial Intelligence to Area 6 of course table

- *Allow students to take It as a technical elective. They currently take it as a technical elective from another department. This will give ECE students equal access to this course and allow greater flexibility.*

2.1.2. ADD ECE318H1 S – Fundamentals of Optics to Fall Semester

- *Add this course to the fall term to give students more flexibility when scheduling their courses. Often, we have 2 winter sections so this could provide more balance.*

2.1.3. Update pre-requisites for ECE441H1 F – Interfacing and Modulating the Nervous System

CURRENT Pre-requisite: BME331H1
PROPOSED Pre-requisite: none

- *Remove the BME331 pre-requisite to make the course more accessible to all students. This would not cause much review within the course.*

**2.2. Update course description for ECE191H1 S – Introduction to Electrical and Computer Engineering**

CURRENT course description: This is a seminar series that will introduce first year students to the wealth of subjects within the field of Electrical and Computer Engineering. Instructors will be drawn from the various research groups within the Department. This course will be offered on a credit/no-credit basis. Credit will not be given to students who attend fewer than 70% of the seminars. Students who receive no credit for the course must re-take it in their 2F session. Students who have not received credit for this course at the end of their 2F session will not be permitted to register in session 2S.

PROPOSED course description: This is a seminar series that will introduce first year students to the wealth of subjects within the field of Electrical and Computer Engineering. Instructors will be drawn from the various research groups within the Department. This course will be offered on a credit/no-credit basis. Credit will not be given to students who attend fewer than 70% of the seminars. Students who receive no credit for the course must re-take it in their 2S session. Students who have not received credit for this course at the end of their 2S session will not be permitted to register in session 3F.

- *Course requires a calendar description update to reflect that this is a winter term course. Just needed a couple of term updates to make sense.*

**2.3. Update pre-requisites for ECE496Y1 - Design Project**

CURRENT Pre-requisite: None

PROPOSED Pre-requisite: Students taking ECE496 must have successfully completed 7 technical elective courses or 6 technical elective courses plus ECE472H1.

- *As capstone is the culmination of what students have studied, they need to have completed a significant amount of the technical aspect of their program.*

**2.4. ADD new course ECE435H1 F – Quantum Computing Hardware**

PROPOSED course title: ECE435H1 F – Quantum Computing Hardware

PROPOSED year and term: **4th year, Fall**

PROPOSED course description:
A review of the principles and practical implementation of quantum processors based on solid state superconducting and semiconductor spin qubits. The focus is on hardware with no overlap with existing Quantum Information or proposed Quantum Algorithms undergraduate EngSci or CompSci courses. A top-down approach is taken starting from the quantum processor architecture and building block specification, to qubit and control and readout circuit modelling, design, fabrication and testing. Topics include the basics of quantum mechanics and quantum computing, superconducting and semiconductor spin qubit physics, fabrication and characterization techniques for qubits, and classical control and readout of qubits. Students will gain hands-on experience with the engineering of a quantum computer, deriving specifications for its quantum and classical hardware building blocks, and designing, modelling, simulating, and testing qubits, control and readout circuits for quantum processors.

PROPOSED Prerequisites: (ECE216H1 or ECE355H1) and (ECE286H1 or ECE302H1) and (ECE335H1 or ECE350H1) and ECE231 and (ECE320H1 or ECE357H1)

- *Interpretation of prerequisites - Undergraduate level knowledge of signals and systems, probability and statistics, quantum mechanics, semiconductors devices, electronics and electromagnetics and microwaves.*

PROPOSED Recommended Preparation: PHY365H1 – Quantum Information

PROPOSED exclusions: none

PROPOSED learning objectives:

- Understand the fundamentals, architecture and limitations of quantum computing hardware
- Understand how to use signal synthesis and processing techniques to control qubits and to read out the results of the
- quantum operations
- Understand the principle of operation and limitations of the main solid state qubit technologies
- Understand how to analyze, model, design and test solid state qubits
- Understand how solid state qubits are manufactured and characterized in volume and the challenges for future scaling
- Gain practical, hands-on knowledge on how to analyze, specify and design the classical

control and readout electronics
- for a quantum processor, independent of and specific to a qubit technology platform
- Use state-of-the-art simulators and instrumentation to model, design and test qubits and quantum processors
- Learn how to engineer and build a quantum computer.

PROPOSED course assessments:
- Labs (20%)
- Midterm exam (40%)
- Final project (40%)

PROPOSED timing: 3 lecture hours per week, 3 lab hours biweekly, 2 tutorial hours per week

PROPOSED AUs: 50% Eng Sci, 50% Eng Design

**2.5. CHANGE second year curriculum**

CURRENT second year curriculum
**Fall term**
ECE201H1F – Electrical and Computer Engineering Seminar
ECE231H1F – Introductory Electronics
ECE241H1F – Digital Systems
ECE244H1F – Programming Fundamentals
MAT290H1F – Advanced Engineering Mathematics
MAT291H1F – Intro. to Mathematical Physics

**Winter Term**
ECE212H1S – Circuit Analysis
ECE216H1S – Signal and Systems
ECE221H1S – Electric and Magnetic Fields
ECE243H1S – Computer Organization
*One of the following:*
ECE295H1S – Hardware Design and Communication
ECE297H1S – Software Design and Communication

PROPOSED second year curriculum
***Computer Engineering***
**Fall term**
ECE201H1F – Electrical and Computer Engineering Seminar
ECE231H1F – Introductory Electronics
ECE241H1F – Digital Systems
ECE244H1F – Programming Fundamentals
MAT290H1F – Advanced Engineering Mathematics
MAT291H1F – Intro. to Mathematical Physics

**Winter Term**
ECE212H1S – Circuit Analysis
ECE216H1S – Signal and Systems
ECE221H1S – Electric and Magnetic Fields
ECE243H1S – Computer Organization
**ECE297H1S – Software Design and Communication**

***Electrical Engineering***
**Fall term**
ECE201H1F – Electrical and Computer Engineering Seminar
ECE231H1F – Introductory Electronics
ECE241H1F – Digital Systems
ECE244H1F – Programming Fundamentals
MAT290H1F – Advanced Engineering Mathematics
MAT291H1F – Intro. to Mathematical Physics

**Winter Term**
ECE212H1S – Circuit Analysis
ECE216H1S – Signal and Systems
ECE221H1S – Electric and Magnetic Fields
ECE243H1S – Computer Organization
**ECE295H1S – Hardware Design and Communication**

- *We wish to remove the option of taking either ECE295 or ECE297.*
- *The proposal is to modify the Academic Calendar such that EE students must take ECE295, and CE students must take ECE297 in their second year.*
- *The key objective of this proposal is to enable a larger portion of students admitted as EE to be more effectively trained in core EE areas (Areas 1-3) encouraging them to graduate with electrical engineering expertise currently in high demand by industry*

**2.6. CHANGE course title and description for ECE446H1 F – Sensory Communication**

CURRENT course title: ECE446H1 F – Sensory Communication

PROPOSED course title: ECE446H1 F – Audio, Acoustics and Sensing

CURRENT course description: Physical acoustics, acoustic measurements, electroacoustic transducers, and physiological acoustics. Speech processing, speech recognition algorithms and signal processing by the auditory system. Engineering aspects of acoustic design. Electrical models of acoustic systems. Noise, noise-induced hearing loss, and noise control. Introduction to vision and other modalities. Musical and psychoacoustics.

PROPOSED course description: Waves, physical, and musical acoustics, musical instruments, electrical and mechanical interfaces for musical expression, electroacoustic transducers, sensing and metasensing, ultrasound, measurement (phase-coherent detection), and physiological acoustics. Speech, music, and interface processing and signal processing, including aspects of the auditory system. Wearable technologies for audio. Engineering aspects of acoustic and electroacoustic design. Electrical models of acoustic systems. Noise, noise-induced hearing loss, and noise control. Introduction to vision and other modalities. Creative and artistic systems and interfaces.

- *This course was previously taught by Professor Will Wong. He will no longer be teaching this course, and it is a core course for the Music Performance minor, so cancelling it is not really an option. Due to the sudden departure of Professor Wong, we were able to have one of his past grad students teach it this year because it was much too late to cancel it. We received special permission from the Faculty to teach this course remotely as the instructor is in the US. We have since found a new champion for this course (Professor Mann), who has made changes to both the title and the course description to reflect what aligns better with his vision for this course.*

**2.7. CHANGE course delivery to add a lab for ECE335H1 F – Introduction to Electronic Devices**

CURRENT course delivery: 3 LEC/0 PRA/2 TUT

PROPOSED course delivery: 3 LEC/3a PRA/2 TUT

- *Students will develop a deeper understanding of the subject matter via a combination of hands-on laboratory experiments and modelling of semiconductor devices, in contrast to the current curriculum where semiconductor devices are only simulated via project assignments. It is noteworthy that the engineering science course equivalent of ECE350 does include practical labs. Note that "3a" means alternating weeks of 3 hours per lab.*

**2.8. UPDATE course description for ECE516H1 S – Intelligent Image Processing**

CURRENT course description: This course provides the student with the fundamental knowledge needed in the rapidly growing field of Personal Cybernetics, including "Wearable Computing", "Personal Technologies", "Human Computer Interaction (HCI)," "Mobile Multimedia," "Augmented Reality," "Mediated Reality," CyborgLogging," and the merging of communications devices such as portable telephones with computational and imaging devices. The focus is on fundamental aspects and new inventions for human-computer interaction. Topics to be covered include: mediated reality, Personal Safety Devices, lifelong personal video capture, the Eye Tap principle, collinearity criterion, comparametric equations, photoquantigraphic imaging, lightvector spaces, anti-homomorphic imaging, application of personal imaging to the visual arts, and algebraic projective geometry.

PROPOSED course description: Provides fundamental knowledge in the expanding field of Intelligent Image Processing, Humanistic Intelligence, Wearable AI, Spatial XR (VR/AR/MR),

Wearable Computing, Human Computer Interaction (HCI)", "Mobile Multimedia", "Augmented Reality," "Mediated Reality," CyborgLogging," vision-based mobility devices and assistive technologies like the "Freehicle" (vehicle of freedom for mobility for persons with disabilities). Key topics include Mersivity (Socio-Cyber-Physical border or boundary between us and our surroundings), vision-based human-computer interaction. Personal Safety Devices, lifelong personal video capture, EyeTap principle, comparametric equations, photoquantigraphic imaging, lightvector spaces, anti-homomorphic imaging, application, algebraic projective geometry of 360-degree imaging, underwater imaging.

- *Change the course description to reflect what is being taught in the course now and in recent years.*

**2.9. ADD new course ECE484H1 S – Quantum Information Processing: Algorithms and Software**

PROPOSED course title: ECE484H1 S – Quantum Information Processing: Algorithms and Software

PROPOSED year and term: 4th year, Winter

PROPOSED course description: Provides a comprehensive understanding of quantum information processing, focusing on software tools and algorithms for quantum computing. The material covers foundational quantum mechanics background, introduces quantum computing basics, and explores key software frameworks and algorithms. Through programming exercises and projects, students develop skills in designing and implementing quantum algorithms. Exercises are conducted using prominent quantum simulators.

PROPOSED Prerequisites: ECE286H1 or ECE302H1

PROPOSED Recommended Preparation: PHY365H1 – Quantum Information

PROPOSED exclusions: none

PROPOSED learning objectives:

- Understand the foundational principles of quantum mechanics as helpful in
- understanding quantum computing.
- Analyze and compare classical and quantum algorithms for various computational
- problems.
- Implement quantum algorithms using state-of-the-art software tooling.
- Assess the impact of noise and error correction in quantum computing.
- Evaluate the potential applications of quantum information processing in different
- domains.
- Understand the limitations of quantum computing as of today.

PROPOSED course assessments:

- Exercises and Assignments (20%)
- Quizzes (10%)
- Midterm exam (30%)
- Final exam (40%)

PROPOSED timing: 3 lecture hours per week, 2 tutorial hours per week

PROPOSED AUs: 50% ES, 50% ED

**2.10. CHANGE course description and offering of ECE999 – Research Thesis**

CURRENT Course description: The course consists of a research project conducted under the supervision of an ECE faculty member. Research projects must be arranged individually between the student and a supervising faculty member, subject to the approval of the Associate Chair, Undergraduate. The thesis should have a research focus. The student's work must culminate in a final thesis document. The student is also required to submit a set of deliverables, including a proposal. The course may be undertaken only once, either in the Fall (F) or Winter (S) Session (0.5 weight), or as a full year (Y) course (1.0 weight).

PROPOSED Course description - The course consists of a research project conducted under the supervision of an ECE faculty member. Research projects must be arranged individually between the student and a supervising faculty member, subject to the approval of the Associate Chair, Undergraduate. The thesis should have a research focus. The student's work must culminate in a final thesis document. The student is also required to submit a set of deliverables, including a proposal. The course may be undertaken only once, either in the Fall (F) Session (0.5 weight), or as a full year (Y) course (1.0 weight).

CURRENT course offering: Fall (F) or Winter (S) Session (0.5 weight), or as a full year (Y) course (1.0 weight).

PROPOSED course offering: Fall (F) Session (0.5 weight), or as a full year (Y) course (1.0 weight); remove the Winter Session offering

- *This course is offered as F, S and Y. After allowing students to take a one term thesis, it was found to be insufficient time for the student to dig deep into the subject. We no longer allow students to register in the winter term session for this course. When students take this course, they can register in ECE499H1 F if it is a continuation of summer research they were doing with a professor, or they can enroll in ECE499Y1 Y. We want to align the calendar with the practice of the department. When students take this course, they can register in ECE499H1 F if it is a continuation of the summer research they did with a professor, or they can enroll in ECE499Y1 Y.*

## 2.11. UPDATE graduate attributes for the following courses:

### 2.11.1. ECE441H1 – Interfacing and modulating the nervous system

ADD:

1C Knowledge Base - Demonstrate competence in specialized engineering knowledge appropriate to the program. [applied]
3C Investigation - Demonstrate the ability to use critical analysis to reach valid conclusions supported by the results of the plan. [applied]
5C Use of Engineering Tools – Show recognition of limitations of the tools used. [applied]
8C Professionalism – Demonstrate the ability to behave in a professional manner. [applied]
10B Ethics and Equity – Demonstrate the ability to apply the Code of Ethics and equity principles. [introduced]

### 2.11.2. ECE313H1 – Energy and Distributed Generation

ADD:

1A Knowledge Base – Demonstrate competence in mathematics and modeling. [applied]
1C Knowledge Base - Demonstrate competence in specialized engineering knowledge appropriate to the program. [developed]
2C Problem Analysis – Demonstrate the ability to formulate and interpret a model. [developed]
5B Use of Engineering Tools – Demonstrate ability to use discipline specific techniques, resources and engineering tools. [applied]
5C Show recognition of limitations of the tools used. [applied]

### 2.11.3. ECE526H1 - Power System Protection and Automation

ADD:

1C Knowledge Base - Demonstrate competence in specialized engineering knowledge appropriate to the program. [applied]
2B Problem Analysis – Demonstrate the ability to formulate a solution plan. [developed]
4D Design – Demonstrate the ability to advance an engineering design to a defined end state. [introduced]
5B Use of Engineering Tools – Demonstrate ability to use discipline specific techniques, resources and engineering tools. [developed]
5C Show recognition of limitations of the tools used. [developed]

### 2.11.4. ECE520H1 – Power Electronics

ADD:

1C Knowledge Base - Demonstrate competence in specialized engineering knowledge appropriate to the program. [applied]
2A Problem Analysis – Demonstrate the ability to identify and characterize an engineering problem. [developed

2C Problem Analysis – Demonstrate the ability to formulate and interpret a model. [developed]
4D Design – Demonstrate the ability to advance an engineering design to a defined end state. [applied]
5B Use of Engineering Tools – Demonstrate ability to use discipline specific techniques, resources and engineering tools. [applied]

2.11.5. ECE444H1 – Software Engineering

ADD:

6A Individual and Team Work – Demonstrate ability to establish and monitor team organization structure. [applied]
6B Individual and Team Work – Demonstrate ability to promote team effectiveness through individual action. [applied
6C Individual and Team Work – Demonstrate success in a team based project. [applied]
7A Communication Skills – Demonstrate the ability to identify and credibly communicate engineering knowledge. [applied]
11B Economics and Project Management – Demonstrate ability to evaluate the economic and financial performance of an engineering activity and compare alternative proposals on the basis of these measures. [introduced]

2.11.6. ECE412H1 – Analog Signal Processing Circuits

CHANGE:

CURRENT graduate attributes: 1B(dev), 1C(dev), 2B(dev), 3A(dev), 5B(app), 5C(app).
PROPOSED graduate attributes: 1A(dev),1C(dev), 2D(dev), 4B(app), 4C(app).

- *Professor Voinigescu says it makes more sense to collect 4B and 4C instead of 5B (Use of Engineering tools – demonstrate ability to use discipline specific techniques, resources and engineering tools) and 5C (Use of engineering tools – Show recognition of limitations of the tools used).*

**2.12. ADD new course ECE442H1 F – Introduction to Micro- and Nano-Fabrication Technologies**

PROPOSED course title: ECE442H1 F – Introduction to Micro- and Nano-Fabrication Technologies

PROPOSED year and term: 4th year, Fall

PROPOSED course description: An introduction to the fundamentals of micro- and nano-fabrication processes with emphasis on cleanroom practices. The physical principles of optical lithography, electron-beam lithography, alternative nanolithography techniques, and thin film deposition and metrology methods. The physical and chemical processes of wet and dry etching. Cleanroom concepts and safety protocols. Sequential micro-fabrication processes involved in the manufacture of microelectronic and photonic devices. Imaging and

characterization of micro- and nano-structures. Examples of practical existing and emerging micro- and nano-devices. Limited enrollment.

PROPOSED Prerequisites**:** ECE335H1 or ECE350H1

PROPOSED timing**:** 2 LEC/4a PRA/2a TUT (0.5 credit value)

PROPOSED AUs: 100% ES

- *ECE stopped offering this course in 2013. Professor Ng would like to resurrect this course.*
- *Semiconductor device fabrication techniques is a topic that is currently not covered in the ECE curriculum, except for quick discussion in ECE437S. To promote more interests in the semiconductor area, this is an important and practical course.*
- *This course would be cross listed with the ECE1460F and would complement the newly proposed course, MSE466/MSE1066 – Practical Aspects of Electron Microscopy.*

## 3. ENGINEERING SCIENCE

### 3.1. REFRESH the Electrical and Computer Engineering (ECE) Major 3rd year program

RATIONALE: The intent of the refresh was to reduce the number of courses per term in Year 3 from 6 to 5 (excluding ESC301 which is a low contact hour seminar type course) which brings the program into alignment with the newer Engineering Science majors. To accommodate this reduction and keep the content possibilities similar to the current program, flexibility was added to the program by providing more "restricted" electives. Restricted electives are those where the student must take X of Y courses. The reduction in courses in year 3 and the increased flexibility were also done to try to increase enrolment in the ECE major as it had been dropping over the years and students had previously expressed concerns regarding the number of courses in year 3 and the desire for more flexibility. Note that changes for year 4 will be forth coming in 2026/27 academic year.

3.1.1. Remove: ECE349H1: Introduction to Energy Systems and ECE352: Computer Organization from 3F core (will become restricted electives in 3F)

3.1.2. Remove: CHE374H1: Economic Analysis and Decision Making from 3F (will be put in 4F in 2026/27)

3.1.3. Remove: ECE353: Systems Software from 3S core (will become restricted elective in 3S)

3.1.4. Remove: One ECE Elective from 3S (electives are now through restricted elective sets)

3.1.5. Remove: Students must take 3 of:
ECE358H1F: Foundations of Computing
ECE350H1S: Semiconductor Electronic Devices
ECE354H1S: Electronic Circuits
ECE357H1S: Electromagnetic Fields
ECE363H1S: Communication Systems

- *These courses are added back in as restricted electives as shown below.*

3.1.6. Remove: Students may take CHE374H1 if 4F, particularly to accommodate ECE358H1 (no longer required as CHE374H1F will be moved to 4F in 2026/27).

3.1.7. Add to 3F:
Choose 1 of 2:
ECE358H1F: Foundations of Computing (previously restricted elective in 3F)
ECE421H1: Introduction to Machine Learning (previously only in ECE Electives list[1])
Choose 1 of 2:
ECE349H1: Introduction to Energy Systems (previously core 3F)
ECE352: Computer Organization (previously core 3F)

3.1.8. Add to 3S:
Choose 2 of 4:
ECE353H1: Systems Software (previously core in 3S)
ECE334H1: Digital Electronics (previously only in ECE Electives list)
ECE363H1: Communication Systems (previously restricted elective in 3S).
ECE361H1: Computer Networks I (previously only in ECE Electives list)

Choose 2 of 5:
ECE313H1: Energy Systems and Distributed Generation (previously only in ECE Electives list)
ECE318H1: Fundamentals of Optics (previously only in ECE Electives list)
ECE350H1: Semiconductor Electronic Devices (previously restricted elective in 3S)
ECE354H1: Electronic Circuits (previously restricted elective in 3S)
ECE357H1: Electromagnetic Fields (previously restricted elective in 3S).

3.1.9. Make following changes to ECE Electives:

a. Add ECE349H1: Introduction to Energy Systems to *Electromagnetics and Energy Systems* group
Rationale: Moved from core to elective so also added to ECE Electives

[1] For courses that were previously only in the ECE Electives list but are now part of a restricted electives list they will also remain in the ECE electives list.

b. Add ECE352H1: Computer Organization to *Computer Hardware and Computer Networks* group
Rationale: Moved from core to elective so also added to ECE Electives

c. Add ECE353: System Software to Software group
Rationale: Moved from core to elective so also added to ECE Electives

d. Change ECE358H1: Foundations of computing in Software group delivery from 3/0/1 to 3/0/2
Rationale: Correct error in program entry of course (i.e. does not agree with course entry)

e. Change CSC343H1: Introduction to Databases in Software group delivery from 2/0/1 to 3/0/0
Rationale: Correct error in program calendar (i.e. does not agree with course entry)

f. Change CSC317H1: Computer Graphics in *Software* group delivery from F/S to F only
Rationale: Correct error in program entry of course-- only offered in F

g. Change CSC318H1: The Design of Interactive Computational Media in *Software* group delivery from 2/0/1 to 2/0/2
Rationale: Correct error in program entry of course

3.1.10. Make Following Changes to Technical Electives

a. Add PHY356H1: Quantum Mechanics I
Rationale: Course good fit for some ECE topics

b. Add PHY358H1: Quantum Materials: from Atoms to Crystals
Rationale: Course good fit for some ECE topics

c. Add PHY365H1: Quantum Information
Rationale: Course good fit for some ECE topics

d. Add PHY485H1: Laser Physics
Rationale: Course good fit for some ECE topics

e. Change ECE367H1: Matrix Algebra and Optimization from S term to F term
Rationale: Correct error in program entry of course

f. Add Course Title for CSC413H1: Neural Networks and Deep Learning (title was missing), and change delivery from 3/0/0 to 2/0/1
Rationale: Correct error in program entry of course

- *Note: Further changes will be coming in 2026-27 to the 4th year calendar for the ECE major.*

**3.2. Add APS380H1 Introduction to Electric Vehicle Design to:**

a. ECE major General Technical Electives
b. Energy major Fall Electives
c. Robotics major Application Electives

Rationale: Provide path to Electric Vehicle Certificate and provide elective course in important field to appropriate majors

**3.3. Add MIE535H1 Electrification Via Electricity Markets to:**

d. MSF major Winter Electives
e. ECE major General Technical Electives
f. Energy major Winter Electives

Rationale: Add relatively new course in important field as elective to appropriate majors

**3.4. Move ESC471H1 Engineering Science Capstone Design (Physics major) from 4F/S to S term.**

Rationale: It has only been offered in one term for several years and moved it to 4S term to provide improved scheduling for Physics shared laboratory space. PHY327 and PHY427 use the same lab space as ESC471 and moving this to 4S will improve scheduling.

**3.5. Remove MIE422: Automated Manufacturing as a Technical Elective for Robotics major**

Rationale: ECE470 *Robot Modeling and Control* which is core for Robotics, is now listed as exclusion for MIE422 due to significant overlap.

**3.6. Add AER306: Introduction to Space Flight to pre-reqs for AER407 Space Systems Design**

Rationale: AER306 was added two years ago and was intended to be pre-req for AER407 but needed to delay adding until 3rd year and returning PEY class finished

**3.7. Remove AER407: Spaces Systems Design from Robotics Major Technical Electives**

Rationale: Robotics students do not take AER306 and therefore there is no path for them to take this course. This was always the intention when Aerospace was refreshed a few years ago.

**3.8. Change course code for BME489: Biomedical Systems Engineering Design to BME470.**

Rationale: BME489: *Biomedical Systems Engineering Design* which is capstone design course for EngSci BME major often gets confused with BME498: *Biomedical Engineering Capstone Design*, which is a capstone design for BME minor.

**3.9. Change ECE286H1 Probability and Statistics to MIE286H1**

Rationale: Increase involvement in MIE in EngSci and return the course to the instructor from 4-5 years ago when course was STA286H1

Change pre-reqs for following courses to agree: ECE324H1, ECE355H1, ECE361H1, ECE368H1, ECE417H1, ECE421H1, ECE464H1, ECE537H1, MIE223H1, MIE368H1, MIE369H1, MIE370H1, MIE375H1, MIE523H1, MIE524H1, ROB311H1, ROB313H1

**3.10. Add BME488H1: Introduction to Immunoengineering as Tech Elective to BME major in subgroup Regenerative Medicine and Biomaterials**

Rationale: New BME course that is appropriate for BME major students

**3.11. Update delivery hours for ESC190: Computer Algorithms and Data Structures from 3/3/2 to 3/3/0 (Lec/Pra/Tut)**

Rationale: Changed to agree with current delivery schedule

**3.12. Update delivery hours for ESC101: Praxis I from 3/1/2 to 3/2/2**

Rationale: Changed to agree with currently scheduled delivery, note that 2 hours Practical have no assigned room or instructor, they are scheduled hours for group design meetings

**3.13. Update delivery hours for ESC102: Praxis II from 3/1/2 to 3/2/2**

Rationale: Same as for ESC101

**3.14. Add BME466 Drug Delivery at Biological Borders and Interfaces to Regenerative Medicine and Biomaterials technical elective group.**

Rationale: New course that is appropriate for BME major students

**3.15. Add EC435H1F Quantum Computing Hardware to ECE Electives subgroup Analog and Digital Electronics, Photonics and Semiconductor Physics, and Computer Hardware**

Rationale: New course in an important and rapidly growing field of importance

**3.16. Add ECE484H1S Quantum Information Processing: Algorithms and Software to ECE Electives subgroup Software and Photonics and Semiconductor Physics.**

Rationale: New course in an important and rapidly growing field of importance

**3.17. Update the delivery hours or term or name for the following courses in the program(s) to agree with course delivery hours Lec/Pra/(Lab)/Tut or other information:**

a) CSB435H1: Change from 2/0/0 to 2/0/1 in BME major
b) CJH332H1: Change from 2/0/0 to 3/0/0 for BME major
c) MAT336H1: Change from 3/0/0 to 3/0/1 for MSF, MI and Physics majors
d) MIE566H1: 493Change from 3/0/3 to 3/2/2 for MSF major

e) JPE395H1: Change from 0/0/0 to 2/0/0 for Energy and Physics majors
f) CSC412H1: Change from 0/0/0 to 2/0/1 for Robotics major
g) JPE493H1: Change from 0/0/0 to 2/0/0 for Physics major
h) PHY452H1: Change from 2/0/0 to 2/0/1 for Physics major
i) PHY460H1: Change from 2/0/0 to 2/0/1 for Physics major
j) PHY483H1: Change from 2/0/0 to 2/0/1 for Physics major
k) PHY484H1: Change from 2/0/0 to 2/0/1 for Physics major
l) PHY485H1: Change course name from Advanced Classical Optics to Laser Physics
m) PHY492H1: Change from 2/0/0 to 2/0/1 for Physics major
n) CSC317H1: Change from F/S to F only
o) ESS445H1: Change from 3/0/0 to 2/2/0 for Physics major
p) CSC343H1: Change from 2/0/1 to 3/0/0 for BME, ECE, MSF and MI majors
q) CSC413H1: Change from 0/0/0 to 2/0/1 for Robotics major, Change from 3/0/0 to 2/0/1 for Physics major
r) CSC318H1: Change from 2/0/1 to 2/0/2 for BME major

## 4. MECHANICAL & INDUSTRIAL ENGINEERING

### 4.1. Change Course code, course name and semester for MIE334 Numerical Methods

CURRENT Semester: 3W
PROPOSED Semester: 2W

CURRENT Name & Course Code: MIE334 Numerical Methods
PROPOSED Name & Course Code: MIE235 Numerical Analysis and Computational Methods

- *The MEC Curriculum Renewal Committee has voted and approved the proposal to move MIE334 Numerical Methods from 3W to 2W, with the primary reason to improve the continuity of the "Math Spine" in the MEC Curriculum. MIE334 currently follows two other math courses in the 2nd year curriculum in MEC (MIE230 Engineering Analysis and MAT234 Differential Equations) and was designed to take engineering math problems that have been developed theoretically in MIE230 and MAT234 and convert them into numerical solutions, with prominent use of MATLAB, Excel, and other computational packages. However, many students find that MIE334 is too far removed from the 2nd year math courses and is too disconnected. Students often spend significant time re-learning the theory from MIE230 and MAT234 to understand the topics in MIE334. Furthermore, MIE334 requires proficiency in computer programming, yet there is also a gap in the amount of programming the students are exposed to from APS106 to MIE334. Thus, to improve continuity of the math spine, we propose to move MIE334 to 2W. This proposal was developed by our 7-member MEC Curriculum Renewal Committee, and then presented at our annual faculty retreat to the MEC Faculty, receiving broad support.*

- *The proposed name and course code change reflects the move to 2nd year, the appropriate emphasis on computation to modernize the title, and the distinction*

*between "analysis", which is more than just teaching the methods but also how to use them critically.*

**4.2. Semester Change of "CS Elective"**

CURRENT Calendar Entry: Complementary Studies Elective in "Winter Session – Year 2"

PROPOSED Calendar Entry: Complementary Studies Elective in "Winter Session – Year 3"

- *To make room for the semester change of MIE334 to 2W, one course needed to be moved from 2W to 3W. The CS Elective was deemed to be the best option to minimize disruption to other parts of the curriculum.*

**4.3. Revisions to Fourth Year Mechanical Engineering Calendar Headings and Footnotes**

- *The current calendar entries for 4th year force the students to take 3 technical electives and 1 CS elective in 4F, and 1 technical elective and 1 CS elective in 4W. This is an unnecessary constraint that reduces flexibility during course selection and adds administrative work to the Undergrad Office. We propose a change to allow students the flexibility to take any number of technical electives and CS electives in either 4F or 4W, as long as the total number of 4 TEs and 2 CS electives is maintained for the 4th year.*

CURRENT Calendar Entries:
*For 4$^{th}$-Year Fall:*
Technical Electives (One of):
Complementary Studies Elective (one): (F)
*For 4$^{th}$-Year Winter:*
Technical Electives (three of):
Complementary Studies Elective (one): (S)

PROPOSED Calendar Entries:
*For 4$^{th}$-Year Fall:*
Technical Electives (Choose total of 4 across Fall and Winter):
Complementary Studies Elective (Choose total of 2 half-credit CS electives across Fall and Winter): F/Y
*For 4$^{th}$-Year Winter:*
Technical Electives (Choose total of 4 across Fall and Winter):
Complementary Studies Elective: (Choose total of 2 half-credit CS electives across Fall and Winter): S/Y

*Footnotes:*

1. *In 4th year, students must take a total of 4 technical electives and 2 CS electives. Students may choose on their own how they prefer to divide these 6 electives between the Fall and Winter sessions.*
2. *Many students have asked for more flexibility in course selection for 4th year. There are*

*many scheduling challenges and students often have to sacrifice a course they are highly interested in taking just to fit another course that they are less interested in into the schedule. Many of these issues are caused by the constraint of forcing students to take exactly 3 technical electives and 1 CS elective in the Fall, and 1 technical elective and 1 CS elective in the Winter. The Undergrad Office deals with many requests for TE substitutes and other requests to approve accommodations to allow alternative courses. The vast majority of these requests are approved anyway because our Undergrad Office is well aware of this unnecessary constraint. Thus, after a thorough review by the MIE Curriculum Renewal Committee, it was unanimously approved to add this flexibility into the 4th year curriculum.*

**4.4. AEMECBASC 3F - Program Change**

Add the following note after the Engineering NSC electives are listed:

*Note:* Students may select a Natural Science elective from the list above or from the list of approved Natural Science courses offered by the Faculty of Arts & Science. This list is available on the Faculty of Engineering website here (link required).

- *The calendar currently lists three specific NSC electives for 3F, but does not mention any of the other many available electives. This often confuses students as they think the three listed NSC electives are the only options, and must formally request permission from the undergraduate office to take other NSC electives.*

**4.5. AEINDBASC – Program Change**

CURRENT:

*Note:* The Industrial Engineering program is undergoing a major curriculum change that will take effect over multiple stages. The fourth year of the program as outlined below corresponds to the requirements of the old program.

PROPOSED:

*Note:* The Industrial Engineering program is undergoing a major curriculum change that will take effect over multiple stages. The fourth year of the program as outlined below corresponds to the requirements of the old program. If you are following the new curriculum, please review the fourth-year requirements here (link required).

- *This revised note directs students who will be enrolled in fourth year in 2025-2026 to the correct fourth-year requirements for the new curriculum.*

**4.6. CHANGE course description, pre-requisites, and semester for MIE354 - Business Process Engineering**

4.6.1. Course Description Change

CURRENT Course Description:

This course focuses on understanding and applying multiple perspectives for organizing, assessing, designing, and implementing integrated distributed information systems to support an organization's objectives. The emphasis is on 1) understanding how Business Process Management techniques and tools can contribute to align an organization's business and information technology perspectives; 2) designing, developing, and deploying Business Processes as information systems. The course introduces blockchain technologies, an emerging class of distributed information system providing the foundation for Web3 decentralized applications. Students will work in the laboratory to develop business processes that integrate blockchain smart contracts, specified using the BPMN industry standard notation. Students will implement and test executable BPMN business processes using an open source BPMN engine together with additional Java programming.

PROPOSED Course Description:
This course focuses on understanding and applying multiple perspectives for organizing, assessing, designing, and implementing integrated distributed information systems to support an organization's objectives. The emphasis is on; 1) understanding how Business Process Management techniques and tools can contribute to align an organization's business and information technology perspectives; 2) designing, developing, and deploying Business Processes as information systems. The course introduces Blockchain technologies, an emerging class of distributed information system providing the foundation for decentralized applications. Students will work in the laboratory to develop business processes that integrate blockchain smart contracts. The business processes will be specified using process modeling languages such as BPMN (an industry standard diagrammatic notation). Students will implement and test executable business processes that combine code generated from process models with additional programming.

- *Eliminating the mention of Java and other specific software packages or languages is a recommended practice because it leaves room to a change in language in future editions of the course without revising the course description.*

4.6.2. Move from Winter Semester to Fall Semester

CURRENT Semester: 3W
PROPOSED Semester: 3F

- *Moving to Fall of 3rd year with only 2nd year pre-requisites will maintain flexibility for students wishing to take this elective in 3rd or 4th year while ensuring that this introductory course for the MINOR IN ADVANCED MANUFACTURING (AEMINADVM) can be taken earlier in the year for the year in which students take it.*

4.6.3. Pre-requisites Change

CURRENT Pre-requisites: MIE353 Data Modelling
PROPOSED Pre-requisites: MIE245, MIE250

- *MIE353 is a core course in 3rd year Fall semester. In order to move MIE354 to the Fall semester and allow students to enroll in both MIE353 and MIE354 simultaneously, MIE353 cannot be a pre-requisite. The appropriate pre-requisite for MIE353 is MIE250. After reviewing the skills needed in MIE354, it was determined that MIE245 and MIE250 would be sufficient as pre-requisites from 2nd year to allow MIE354 to move to 3F.*

**4.7. Reactivate and change MIE464 - *Smart Materials and Structures**

- *Course Reactivation, Course Code, Course Description, and Pre-Requisites Changes*

4.7.1. Reactivate MIE464

- *The course is currently inactive and needs to be reactivated to allow the following changes.*

4.7.2. Course Code and Name Change

CURRENT Name and Course Code: MIE464 – Smart Materials and Structures
PROPOSED Name and Course Code: MIE564 – Smart Materials and Manufacturing

- *MIE464 was placed on hiatus as a 4th year elective a while ago, which left the previously cross-listed course MIE1740 as a standalone grad-level course on this topic. However, there is now interest by the department to reactivate this course for undergraduate students. Rather than reactivate it as a 400-level course and cross-list it again with MIE1740, our decision is to change it to a 500-level course instead. This adjustment means that it will no longer be cross listed with MIE1740 and will instead be an undergraduate course that graduate students will have access to. Unlike a cross-listed course, this 500-level course will have the same assessments and syllabus for both graduate and undergraduate students.*

- *The rationale for the title change from "Smart Materials and Structures" to "Smart Materials and Manufacturing" involves a combination of four factors: 1) increase the manufacturing content in our curriculum and offerings based on undergraduate curriculum recommendations; 2) provide students with more courses related to manufacturing especially on "smart" factories, Industry 4.0, and IoT in manufacturing; 3) have an alternate course for FASE undergraduate students in the Advanced Manufacturing minor, and 4) provide MSE students with more course offerings in the manufacturing stream.*

4.7.3. Course Description Change

CURRENT Course Description:
Smart materials are characterized by new and unique properties that can be altered in response to environmental stimuli. They can be used in a wide range of applications since

they can exceed the current abilities of traditional materials especially in environments where conditions are constantly changing. This course is designed to provide an integrated introduction to smart materials and structures, and provide a strong foundation for further studies and research on these materials. Topics include: structure, processing, and properties of smart materials; dependence of properties on structure; processing and design; mechanical, thermal, electrical, magnetic and optical smart materials systems such as shape memory materials, electrostrictive materials, magnetostrictive materials, active polymers; design, modeling and optimization of smart materials systems using CAD and FEA software packages.

PROPOSED Course Description:
Smart materials are characterized by new and unique properties that can be altered in response to environmental stimuli. They can be used in a wide range of applications since they can exceed the current abilities of traditional materials especially in environments where conditions are constantly changing. Smart manufacturing refers to the use of the holistic integration of modern technologies with the data analytics, automation and computing to form a new efficient and adaptable manufacturing framework. An integrated introduction to smart materials and manufacturing is provided, thereby offering a strong foundation for further studies and research. Topics include: smart materials processing and design; mechanical, thermal, electrical, magnetic and optical smart materials systems with applications in sensors, soft robotics, energy systems; introduction to industry 4.0 and Smart Factory, Internet of Things (IoT) platforms, advanced human-machine interfaces, wearables, smart sensors, smart machines.

- *New course description provides a more accurate summary of course topics after changes to course title and content, reflecting an increased emphasis on manufacturing.*

4.7.4. Pre-Requisites Change

CURRENT pre-requisites: MSE101H1, MIE270H1/MSE235H1, MIE222H1/MSE316H1
PROPOSED pre-requisites: MIE270 and MIE222, or MSE120 and MSE222, or equivalent

- *MIE270 and MIE222 are the two critical pre-requisites from the MEC curriculum that are both required background for the proposed course. Since the course is expected to attract MSE students, and in part be attractive to MSE students who transfer into MIE, it was deemed important to specify the equivalent courses in the MSE that are similar to MIE270 and MIE222. MSE222 is the equivalent of MIE222, and MIE120 has significant overlap with MIE270. Students may also request approval of transfer credits from other courses that have potential to be considered equivalent to MIE270 and MIE222.*

4.7.5. Add as Technical Elective for MEC 4W. (See Rationale in (b).)

**4.8. CHANGE course title and course description for MIE515 - Alternative Energy Systems**

CURRENT Title and Course Description:

MIE515H1: Alternative Energy Systems
This course covers the basic principles, current technologies and applications of selected alternative energy systems. Specific topics include solar thermal systems, solar photovoltaic systems, wind, wave, and tidal energy, energy storage, and grid connections issues. Limited enrolment.
PROPOSED Title and Course Description:

MIE515H1: Sustainable Energy Systems
This course provides students with the knowledge and skills to evaluate different sustainable energy systems. The course overviews the basic operating principles of different current sustainable energy technologies, the social and economic considerations for implementing these systems, and overviews examples of implementations. Specific topics include solar thermal systems, solar photovoltaic systems, wind, wave, and tidal energy, energy storage, and considerations when connecting to the grid. Limited enrolment.

- *The request is to update the name of MIE515 "Alternative Energy Systems". The course has been around for a while and at the time it was started, topics covered in the course, such as renewable energy, energy storage, and concerns with grid integration, were seen as the "alternative" to traditional fossil fuels. The proposed change is recognizing that these types of systems are no longer seen as being alternative to fossil fuels but are seen as the pathway towards sustainability. In addition, the approaches covered are highlighted in the UN Sustainable Development Goals. As such, we are requesting to update the name to "Sustainable Energy Systems".*

**4.9. CHANGE pre-requisites for MIE540 - * Product Design**

CURRENT Pre-requisites: MIE231H1/MIE236H1 or equivalent, MIE243H1 or instructor's permission

PROPOSED Pre-requisites: None (remove all)

- *The proposal is to remove the pre-requisites. The course has evolved over the years. There is less emphasis on math and statistics and more focus on the design process & tools. MIE236/MIE231 was required years ago when the course covered ANOVA (during Design of Experiments). The course still has a strong DOE component, but the instructor does not get into the same level of detail. MIE243 is a good pre-requisite for the course but in 4th year and at the graduate level, students have obtained some exposure to mechanical systems. The instructor has found that the current pre-requisites discourages other disciplines (e.g., MMS, CHE, CIV, ENG SCI) from taking the course. Students from other disciplines have often added value to the course and group projects.*

### 4.10. ADD as a 4th year Technical Elective APS380 - Introduction to Electric Vehicle Design

- *The course was designed with the intent of being a technically focused course suitable as a TE. In addition, as part of the EV certificate and eventual Minor in EV Design, it was expected to be part of the list of TEs. Otherwise, students would have a difficult time enrolling in it. The only reason the course is not already a TE is that APS380 was urgently approved for delivery in 2024-2025, and the opportunity to make it a TE had already passed.*

### 4.11. Change recommended preparation for MIE519 - * Advanced Manufacturing Technologies

ADD MIE270 as "Recommended Preparation"

- *The proposal is to add MIE270H1 as recommended preparation; students without a materials science background have struggled in this class. Adding MIE270H1 might encourage students to be more thoughtful about enrolling in MIE519H1 if they have not taken MIE270H1.*

### 4.12. APS360 - Applied Fundamentals of Deep Learning

ADD APS360 to the list of technical electives for 3F and 4F

- *This course is offered in the Fall and Winter; it is currently listed only as an option for 3W and 4W.*

### 4.13. ADD APS502 - Financial Engineering to list of technical electives for 4W

- *This course is offered in the Fall and Winter; it is currently listed only as an option for 4F.*

### 4.14. Change course code for MSE543 - Composite Materials Engineering

CURRENT Code: MSE443
PROPOSED Code: MSE543

- *This is simply a calendar correction: MSE543 is the new course code for MSE443.*

### 4.15. Change pre-requisite for MIE270 – Materials Science

CURRENT Pre-requisites: APS110/APS164/MSE101
PROPOSED Pre-requisite: APS110/APS164/MSE101/MSE160

- *Adding the Engineering Science equivalent (MSE160) to the list of pre-requisite courses allows the MIE UG Office to more efficiently conduct pre-requisite checks for students enrolled in MIE270.*

### 4.16. Change calendar entry MIE437H1 - Fundamentals of Injury Biomechanics and Prevention

CURRENT Calendar Entry: MIE437H1 (not offered in 2024-2025)
PROPOSED Calendar Entry: MIE437H1-Fundamentals of Injury Biomechanics and Prevention

- *The course is ready to be offered for 2025-2026. Thus, we are removing the note that the course is "not offered in 2024-2025" in list of technical electives.*

### 4.17. Change pre-requisites and exclusions for MIE245 - Data Structures and Algorithms

CURRENT Exclusions: CSC373
PROPOSED Exclusions: CSC263 or CSC373

- *Last year, we added CSC373 as an exclusion. At Faculty Council last year, EngSoc Student Representative (Matthew Du) pointed out that CSC263 also should be an exclusion due to significant overlap.*

### 4.18. Change pre-requisites for MIE369 - Introduction to Artificial Intelligence

CURRENT Pre-requisites:
MIE250H1/ECE244H1/ECE345H1/CSC263H1/CSC265H1, MIE236H1/ECE286H1/ECE302H1

PROPOSED Pre-requisites:
MIE250H1/ECE244H1/ECE345H1/CSC263H1/CSC265H1/ESC190,
MIE236H1/MIE286H1/ECE302H1

- *ESC190 is an acceptable alternative in the first group of prereqs (programming/data structures) that is intended to broaden access to MIE369. ECE286 will be changed to MIE286.*

### 4.19. Change pre-requisites for MIE222 - Mechanics of Solids 1

Current Pre-requisites: None
Proposed Pre-requisites: CIV100/CIV102, MIE100/PHY180

- *MIE222 requires strong background knowledge in mechanics introduced in first year. These pre-requisites have been missing in the pre-req chain for MIE222 for a long time. Students who have not demonstrated proficiency in CIV100 and MIE100 are those who struggle the most in MIE222.*

### 4.20. Change curriculum components for MIE507 - Heating, Ventilating, and Air Conditioning (HVAC) Fundamentals

Current Curriculum Components Distribution: 100% ES
Proposed Curriculum Components Distribution: 50% ES + 50% ED

- *The second half of the course is based on design of HVAC systems (e.g. duct sizing, fan*

*sizing, system layout, diffuser selection, etc.) There is a large group design project that contributes 30% to the final grade. Thus, listing the course as 100% ES was deemed as not representative.*

### 4.21. MIE343/MIE4XX/MIE1411 – Industrial Ergonomics and the Workplace

Double-code MIE1411 as a 4th year Technical Elective (TE) MIE4XX.

CURRENT course codes/descriptions:

*MIE343H1 - Industrial Ergonomics and the Workplace*
The Biology of Work: anatomical and physiological factors underlying the design of equipment and workplaces. Biomechanical factors governing physical workload and motor performance. Circadian rhythms and shift work. Measurement and specification of heat, light, and sound with respect to design of the work environment. The influence of practical and psychosocial factors on workplace ergonomic decision-making.

*MIE1411: Design of Workplaces*
Introduction to ergonomics in industrial settings. Biomechanics related to manual materials handling, repetitive strain injuries, visual and auditory limitations, human information processing and short-term memory limitations, psychomotor skill, anthropometry and workspace layout, population stereotypes, design of controls and displays, circadian rhythms and design of shift work schedules. (MIE343 anti-requisite.)

PROPOSED double-coded course:
*MIE4xx / MIE1411: Industrial Ergonomics and the Workplace*
*Note: This would mean that MIE343 is now re-numbered to the new MIE4XX course.*

PROPOSED Course Description:
The Biology of Work: anatomical and physiological factors underlying the design of equipment and workplaces. Biomechanical factors governing physical workload and motor performance. Circadian rhythms and shift work. Measurement and specification of heat, light, and sound with respect to design of the work environment. The influence of practical and psychosocial factors on workplace ergonomic decision-making.

- *The two courses cover the same content in lectures. The assessments are however different, with the graduate student assessments being more practice-oriented. MIE343 used to be a core course for Industrial Engineering undergraduate students. Now it is being offered as an upper-year elective. The course currently attracts about 30 students. MIE1411, its graduate level equivalent, attracts a similar number. Given the significant overlap between the two courses and the current class sizes, merging of the two courses would enable FASE to use its resources more efficiently. An important reason why a 500-level course was not pursued in this case is that MIE1411 attracts roughly a dozen students from Public Health, and they are not allowed to take our 500-level courses.*

PROPOSED Semester:
Add to 4th year Technical Elective List; keep it also in the 3rd year Technical Elective list.

## 4.22. Change course offerings for MIE440 – Design of Effective Products

CURRENT Course Offerings: MIE440 – Design of Effective Products

PROPOSED Course Offerings:

- MIE445H1 – * Design of Effective Products (same title, new course code)
- MIE440H1 - *Early-Stage Design Methods (new course, use old course code)

a) PROPOSED MIE445H1 – * Design of Effective Products

CURRENT course description: Products should be used as intended to be effective. Thus, a primary goal is to better align designer intention and user behavior. More specifically, sustainability-minded products should be technically efficient, but also support people to use them more sustainably. Finally, many products and systems nudge people to behave in ways contrary to the user's best interests. To address the above, the course focuses on design that increases intended product use, and pro-social / pro-environmental behaviors. For projects, students will develop, prototype and test concepts that aim to increase desired behaviors. Methods relevant to the design of all products include: identification of unmet/underserved user needs through lead users; roles of function and affordance in effective products; fixation and cognitive biases as obstacles to creativity; concept generation methods (e.g., Theory of Inventive Problem Solving (TRIZ/TIPS), use of stimuli and analogy); configuration design methods (e.g., design for transformation, manufacture, assembly, reuse, repair, and recycling).

PROPOSED course description: Products should be used as intended to be effective. Thus, product design must better incorporate possible user behavior. For example, sustainability-minded products should be both technically efficient, and support people to use such products more sustainably. In addition, many products and systems nudge people to behave in ways contrary to the user's best interests. To address the above, the course focuses on design that increases intended product use, and pro-social / pro-environmental behaviors. For projects, students will develop, prototype and test concepts that aim to increase desired behaviors.

PROPOSED Exclusion: MIE440H1

PROPOSED Prerequisite: MIE221H1 or instructor permission

PROPOSED Recommended Preparation: MIE240H1, MIE242H1, MIE243H1, MIE315H1, MIE345H1

b) PROPOSED new course: MIE440H1 - *Early-Stage Design Methods

PROPOSED Course Description:
This course will present design methods that focus on the conceptual and configuration stages of product design. Methods include: identification of unmet/underserved user needs through lead users; roles of function and affordance in products; fixation and cognitive biases as obstacles to creativity; concept generation methods (e.g., Theory of Inventive Problem Solving (TRIZ/TIPS), use of stimuli and analogy); configuration design methods (e.g., design for transformation, manufacture, assembly, reuse, repair, and recycling).

PROPOSED Exclusion: MIE4XXH1 (MIE445H1)
PROPOSED Pre-requisites/ Recommended preparation: none

- *MIE440 is a 4th year technical elective that is open to both MEs and IEs (with permission by instructor needed for IE students to get around the manufacturing course prerequisite). The course currently includes a project component for all students. However, IE students often struggle due to lack of mechanical engineering design background, even though they find the lecture materials beneficial to their other courses. Furthermore, TAs that currently advise students on these term projects often still require direct input from the instructor. Having two separate course codes for the same course would allow the following:*
  i) *One course that does not include a project, with fewer enrollment restrictions including prerequisites, to cater to the students who find the MIE440 course material beneficial to them in projects outside the course.*
  ii) *Another course that closely mirrors the current MIE440, with a project, but with a much more limited enrollment, so that the instructor can personally advise all the projects myself if needed.*

**4.23. ADD as Technical Elective to MEC program MIE535 - Electrification Via Electricity Markets**

PROPOSED that MIE535 be a TE for MIE's MEC program.

- *The course was designed for all engineering students interested in working in the electricity related industries. Note that the course has been added to the EV Minor program and several of the EngSci options.*

**4.24. CHANGE course title and description for MIE365 – Advanced OR**

CURRENT title: Advanced OR
PROPOSED title: Advanced Operations Research

CURRENT Course Description:
Linear programming extensions: goal programming, column generation, interior point solution methods, game theory applications, quadratic programming, bi-level programming,

stochastic programming. Mathematical Programming formulation choices. Evolution of dynamic programming into Markov decision processes and reinforcement learning.

PROPOSED Course Description:
Linear programming extensions: goal programming. Cooperative game theory (Shapley values and nucleolus), interior point methods, large scale decomposition methods (Lagrangian relaxation, Dantzig-Wolfe decomposition, Benders decomposition and column generation), stochastic programming. Karush-Kuhn-Tucker (KKT) conditions with application to quadratic programming and bi-level programming. Mathematical Programming formulation choices. Markov decision process (MDP) problems.

- *As a result of the recent IND curriculum changes, 2 weeks of material on Markov Decision Processes were moved from this course to MIE263 - Stochastic OR. Thus, there is no longer a need to derive the MDP algorithms which are covered in MIE263. This allows MIE365 to cover more mathematical programming decomposition methods, which are required to solve increasingly larger problems.*

**4.25. CHANGE contact hours for tutorial for MIE353 – Data Modelling**

CURRENT timetable: 3 LEC/2 PRA/0 TUT
PROPOSED timetable: 3 LEC/2 PRA/ 1 TUT

- *While the practical covers the application of lecture topics to real-life problems, it is inadequate as a forum for addressing student questions about the lecture material. A tutorial can be focused on topics that are driven by the students' questions.*

**4.26. Industrial Engineering Curriculum Renewal Passed as Omnibus Proposal in December 2022**

Summary of Changes for 2025-2026 (Proposed Fall 2024):
MIE469H1(S): Reliability and Maintainability Engineering (New Description, pre-requisites)
MIE542H1(S): Human Factors Integration (New Description)
MIE561H1(S): Healthcare Systems (New Title)
MIE567H1: Dynamic & Distributed Decision Making (New Title and Description)

4.26.1. UPDATE course description and pre-requisites for MIE469 - Reliability and Maintainability Engineering

CURRENT Course Description:
An introduction to the life cycle costing concept for equipment acquisition, operation, and replacement decision-making. Designing for reliability and determination of optimal maintenance and replacement policies for both capital equipment and components. Topics include: identification of an item’s failure distribution and reliability function, reliability of series, parallel, and redundant systems design configurations, time-to-repair and maintainability function, age and block replacement policies for components, the economic life model for capital equipment, provisioning of spare parts.

PROPOSED Course Description:
An introduction to the life cycle costing concept for equipment acquisition, operation, and replacement decision-making. Designing for reliability and determination of optimal maintenance and replacement policies for both capital equipment and components. Introduction to quality engineering, statistical process control and process capability analysis. Topics include: identification of an item's failure distribution and reliability function, reliability of series, parallel, and redundant systems design configurations, age and block replacement policies for components, the economic life model for capital equipment, provisioning of spare parts.

- *Coverage of quality control content has been added (and other non-essential content removed) to account for the fact that students may not have seen this content in the new curriculum and hence provide context for the product-oriented obverse of machine-oriented reliability and maintenance.*

CURRENT Pre-requisite: MIE231H1/MIE236H1 or equivalent, MIE258H1
PROPOSED Pre-requisite: MIE231H1/MIE236H1/MIE286H1 or equivalent, MIE358H1/CHE374H1

- *Prerequisite change due to course number change and for expanding known equivalent courses. Expansion involves including ECE286, which will become MIE286 (based on proposal by EngSci).*

4.26.2. UPDATE course description for MIE542 – Human Factors Integration

CURRENT Course Description: The integration of human factors into engineering projects. Human factors integration (HFI) process and systems constraints, HFI tools, and HFI best practices. Modelling, economics, and communication of HFI problems. Examples of HFI are drawn from energy, healthcare, military, and software systems. Application of HFI theory and methods to a capstone design project, including HFI problem specification, concept generation, and selection through an iterative and open-ended design process.

PROPOSED Course Description: The integration of human factors into engineering projects. Human factors integration (HFI) process and systems organizational/process constraints, HFI tools, and HFI best practices. Examples of HFI are drawn from energy, healthcare, military, and software systems. Application of HFI theory and methods to a capstone design project, including HFI problem specification, requirements generation, concept development, communication of design issues, and consideration of risk, through an iterative and open-ended design process.

- *Minor changes reflecting course evolution.*

4.26.3. Change course title for MIE561 - Healthcare Systems

CURRENT Title: Healthcare Systems
PROPOSED Title: Case Studies in Healthcare

- *The proposed title better matches the course description.*

4.26.4. CHANGE Title and Course Description for MIE567H1 - Dynamic and Distributed Decision Making

CURRENT Title: Dynamic and Distributed Decision Making
PROPOSED Title: Multi-Agent Reinforcement Learning

Current Calendar Description: Fundamental concepts and mathematical frameworks for scientific sequential decision making in the presence of uncertainty. Utility theory, uncertainty modeling, theory of games, dynamic programming, and multi-agent system. Discussion of how the decision theories can be applied to design algorithms and processes for real-world cases.

New Calendar Description: Fundamental concepts and mathematical frameworks for sequential decision making of a team of decision makers in the presence of uncertainty. Topics include Markov decision processes, reinforcement learning, theory of games and stochastic games, multi-agent reinforcement learning and decentralized Markov decision processes. The course places an emphasize on conceptual understanding of core concepts and expects students to be able to implement the concepts to demonstrate their understanding.

- *The course has been covering topics such as Markov decision process, stochastic games and multi-agent reinforcement learning with significant programming projects. Although the current course materials are mostly consistent with the calendar description, students often come to the class with diverse expectation depending on their interpretation of the calendar description. Therefore, the course instructor would like to make the proposed changes to reduce the discrepancy.*

**4.27. ADD the two new BME courses as Technical Electives for both MEC and IND**

Two new biomedical engineering courses have been proposed (see Section 7):
a) BME488 – Introduction to Immunoengineering
b) BME466 – Drug Delivery at Biological Barriers and Interfaces

- *To encourage enrolment and facilitate uptake of these courses, MIE department will add these to our list of 4th year technical electives for both the MEC and IND programs.*

# 5. MATERIALS SCIENCE & ENGINEERING

## 5.1. UPDATE course description for MSE244

CURRENT Course Description: Basic materials processing flowsheet including priIntroduction to atomic and molecular structures, acid-base and redox reactions, transition metal complexes, and detailed chemical properties of the main group elements in the periodic table. Examples of industrial practice in metal processing industry and energy generation/storage technologies. Hands-on qualitative and quantitative analyses of inorganic compounds, by both classical "wet" volumetric and instrumental methodsmary processing and recycling of materials. Materials and energy balance of individual units and of overall process flowsheets. Use of computer software for flowsheet evaluation. Translating process flowsheets to resource and utility requirements, capital/operating cost, and environmental impact of processing operations. Basics of equipment sizing, operation scheduling, and plant layout.

PROPOSED Course Description: Review of atomic, molecular, and crystal structures. Covering acid-base and redox reactions and chemical properties of the groups in the periodic table. Concluding with an introduction to materials and energy balance in reactions, as well as kinetics and catalysis. Hands-on qualitative and quantitative analyses of inorganic compounds, by both classical "wet" volumetric and instrumental methods. Emphasis will be placed on a chemistry-based motivation of the course content.

- *Course title and/or descriptions are being updated to better reflect content being taught*

## 5.2. UPDATE course description and title for MSE403

CURRENT Title: Data Sciences and Analytics for Materials Engineers

PROPOSED Title: Advanced A.I. for Accelerated Materials Discovery

CURRENT Course Description: Introduces the elements of data sciences, materials informatics and data analytics in materials science and engineering. The focus will be on the applications of this emerging field for accelerated materials development. The students will also be exposed to machine learning approaches such as supervised and unsupervised learning; linear, non- linear, and logistic regression, decision trees, and artificial neural networks. They will also be trained on programming these algorithms in python and applying them for a set of case studies pertaining to structure- property relations in materials science, alloy design, additive manufacturing, and green energy technologies.

PROPOSED course description: Delving into the cutting- edge field of AI-driven materials discovery, equipping students with the tools to develop advanced algorithms that can autonomously learn from data, make predictions, and direct future experiments. Students will explore how AI models such as decision trees, Bayesian optimization, and

other statistical methods can be combined with adaptive strategies to propose new experiments and calculations in an iterative loop. Building on the foundations from MSE 465, with a hands-on emphasis on the design and implementation of AI workflows. Students will practice balancing exploration and exploitation strategies, as well as design their own. Culminating in a final project where students will deploy their workflows to control a self-driving lab, guiding an autonomous materials optimization campaign.

- *Course title and/or descriptions are being updated to better reflect content being taught*

**5.3. UPDATE course description for MSE459**

CURRENT Course Description: Various synthesis techniques to produce nanostructured materials will be introduced. These include methods involving the vapor phase (physical and chemical vapor deposition, organometallic chemical vapor deposition), the liquid phase (rapid solidification, spark erosion), the solid phase, (mechanical attrition, equal channel deformation) as well techniques producing these structures from solution (electrodeposition, electroless processing, precipitation). Secondary processing techniques to produce final products or devices will also be discussed.

PROPOSED Course Description: Various synthesis techniques to produce nanostructured materials will be introduced. These synthesis techniques are categorized into chemical methods and physical methods. The chemical methods module discusses the general principles of nucleation and growth and covers specific chemical reactions for nanomaterial synthesis. The physical methods module introduces nanomaterials synthesis by solid-state processing, liquid-phase processing, vapor-phase processing, etc. In addition, the fundamental properties of nanomaterials introduced and the basic solid-state physics for nanocrystalline materials and advanced technologies for nanomaterial characterizations reviewed.

- *Course title and/or descriptions are being updated to better reflect content being taught*

**5.4. UPDATE course description for MSE332 Heat and Mass Transfer for Materials Processing**

CURRENT Course Description: Fundamental concepts of heat and mass transfer as applied in materials engineering. Steady state and transient analysis in slabs, cylinders and spheres through solutions of problems in metallurgy and material processing. Similarity between heat and mass transfer. Concepts of momentum, mass and thermal boundary layers. Coupled problems.

PROPOSED Course Description: Fundamental concepts of momentum, heat, and mass transfer as applied in materials engineering. Development of approximate analytical descriptions of fluid velocity, temperature, and concentration distributions, including momentum, mass, and thermal boundary layers. Steady state and transient analyses of heat and mass transport in slabs, cylinders, and spheres. Emphasis on appreciating physical behaviour through solutions of problems in metallurgy and material processing.

- *Course title and/or descriptions are being updated to better reflect content being taught*

**5.5. UPDATE course description for MSE468H1: Additive Manufacturing of Advanced Engineering Materials**

CURRENT Course Description: The one-week intensive course includes additive manufacturing (AM) process fundamentals, material properties, design rules, qualification methods, cost and value analysis, and industrial and consumer applications of AM. Particular emphasis will be placed on AM technologies for metals and other advanced materials (ceramics and composites), and related design principles and part performance. The AM techniques introduced in this course include, but are not limited, to selective laser melting, direct metal deposition, wire arc deposition, cold spray, powder binder jetting, electroplating, fused deposition modeling (FDM) and stereolithography (SLA).

Lab activities (virtual / hands-on) involving both desktop and industrial-grade 3D printers for metals, ceramics and composites, addressing the full workflow from design to characterization. Several interactive case studies which deploy quantitative analysis tools discussed in lecture to solve a real or imagined market or business need. Virtual / in-person visits to local AM startups and an AM equipment provider/integrator. A multidisciplinary team of speakers including industry experts, and special guest speakers (some are U of T Alumni). This course provides students with a comprehensive understanding of AM technology, its applications, and its implications both now and in the future.

PROPOSED Course Description: One-week intensive course covering additive manufacturing (AM) process fundamentals, material properties, design rules, qualification methods, cost and value analysis, and industrial and consumer applications of AM. Particular emphasis will be placed on AM technologies for metals and other advanced materials (ceramics and composites), and related design principles and part performance. The AM techniques introduced in this course include, but are not limited, to selective laser melting, direct metal deposition, wire arc deposition, cold spray, powder binder jetting, electroplating, fused deposition modeling (FDM) and stereolithography (SLA).

Lab activities (virtual / hands-on) involving both desktop and industrial-grade 3D printers for metals, ceramics and composites, addressing the full workflow from design to characterization. Several interactive case studies which deploy quantitative analysis tools discussed in lecture to solve a real or imagined market or business need. Virtual / in-person visits to local AM startups and an AM equipment provider/integrator. A multidisciplinary team of speakers including industry experts, and special guest speakers (some are U of T Alumni). Provides students with a comprehensive understanding of AM technology, its applications, and its implications both now and in the future.

- *This course is offered in a non-standard term format. Please consult faculty timetable.*
- *Course descriptions are being updated to provide students with clarifying information*

*about the course offering*

**5.6. CHANGE in 4th-year curriculum to allow students to choose ONE of two core courses**

MSE year 4 students will choose ONE of the two following as a core courses:
1. MSE401 Materials Selection for Sustainable Product Design
2. MSE543 Composite Materials Engineering

- *Upon curriculum review, Materials selection is a critical component of MSE.*
- *MSE students would benefit from having the option to select one of their fourth year core courses, based on the emphasis they'd like to structure their degree.*

**5.7. CHANGE term of offering for MSE351**

CURRENT term: Year 3 Fall
PROPOSED term: Year 3 Winter

- *Due to pre-requisite considerations, the term of course offerings should be changed*

**5.8. CHANGE term of offering for MSE332**

CURRENT term: Year 3 Winter
PROPOSED term: Year 3 Fall

- *Due to pre-requisite considerations, the term of course offerings should be changed*

**5.9. CHANGE in tutorial delivery for MSE438**

CURRENT timetable: 2 LEC hours, 2 PRA hours, and 1 TUT hour each week
PROPOSED timetable: 2 LEC hours and 2 PRA hours

- *Currently 2 LEC / 2 PRA / 1 TUT, however tutorial content can be delivered online and integrated into LEC and PRA*

**5.10. CHANGE in tutorial delivery for MSE222**

CURRENT timetable: 2 TUT hours, alternate weeks; 3 PRA hours, alternate weeks
PROPOSED timetable: 1 TUT hour per week; 3 PRA hours alternate weeks

- *Currently 2hr TUT every other week, modifying to 1hr TUT every week will ensure students are able to stay on top of their learning without reduction to contact hours*

**5.11. ADD new course MSE466/MSE1066: Practical Aspects of Electron Microscopy**

PROPOSED Course Description: Theoretical background of electron microscopy and have hands-on experience of operating the instrument as well as performing sample preparation and data analysis. Lecture topics include instrumentation, fundamentals of electron scattering, scanning electron microscopy (SEM), electron diffraction techniques, phase

contrast imaging, scanning transmission electron microscopy (STEM), sample preparation techniques, and energy dispersive X-ray spectroscopy. Lab sessions will cover SEM, transmission electron microscopy (TEM), and chemical mapping via energy-dispersive X-ray spectroscopy.

- *This course is offered in a non-standard term format. Please consult faculty timetable.*

PROPOSED Course Delivery: 15LEC / 15PRA / 5 TUT (1 week intensive summer course)
PROPOSED Exclusion: ESS425

- *MSE1066 is a current graduate course. MSE department would like to open the course up to undergraduate students as well*

**5.12. ADD Pre-requisites and Co-requisites to Calendar**

- *Currently pre-requisites and co-requisites are not listed for majority of MSE core courses as previously students were assumed to progress through the program without any modifications. Having pre-requisites and co-requisites stated will support academic planning.*

| Code | Course Title | Pre-Requisite | Co-Requisite |
|---|---|---|---|
| MSE120 | Materials Engineering, Processing and Application | | |
| MSE202 | Thermodynamics I | APS110/MSE160; MAT187/ESC195; or equivalent | MAT294 or equivalent |
| MSE219 | Structure and Characterization of Materials | APS110/MSE120/MSE160 or equivalent | |
| MSE244 | Inorganic Materials Chemistry and Processing | APS110/MSE160 | |
| MSE294 | Communications I | APS112/ESC102 | |
| MSE222 | Mechanics of Solid Materials | APS110/MSE160; CIV100/CIV102; MAT187/ESC195 | |
| MSE217 | Diffusion and Kinetics | APS110/MSE160; MAT187/ESC195 | |
| MSE218 | Phase Transformations | MSE202, MSE219; MSE217; or equivalent | |
| MSE238 | Engineering Statistics and Numerical Methods | APS106/ESC180; MAT294 | |
| MSE245 | Organic Materials Chemistry and Properties | MSE244 | |
| MSE302 | Thermodynamics II | MSE202 | |

| Code | Course Title | Pre-Requisite | Co-Requisite |
|---|---|---|---|
| MSE316 | Mechanical Behaviour of Materials | MSE219; MSE218; MSE222; or equivalent | |
| MSE332 | Heat and Mass Transfer for Materials Processing | MAT187/ESC195, MSE217; MSE202 | |
| MSE396 | Materials Manufacturing and Design I | MSE222; MSE295 | |
| MSE335 | Materials Physics | MAT294, MSE219; or equivalent | |
| MSE351 | Design and Sim of Materials Processes | MSE218; MSE238; MSE316; MSE332 | |
| MSE355 | Materials Production | MSE302, MSE217 | |
| MSE543 | Composite | MSE245, MSE316 or equivalent | |
| MSE415 | Environmental Degradation of Materials | MSE244; MSE245; MSE302 | |
| MSE498 | Capstone Project: Design of Materials Processes | All Y3 core courses | |

- *Adding pre-requisite formally will allow for in-depth coverage of course without having to repeat introductory materials, already covered by other MSE courses*

| Code | Course Title | Pre-Requisite | Co-Requisite |
|---|---|---|---|
| MSE403 | Advanced A.I. for Accelerated Materials Discovery (Proposed) | MSE465 | |
| MSE459 | Synthesis of Nanostructured Materials | MSE219; MSE244 | |

## 6. FIRST-YEAR PROGRAM

### 6.1. CHANGE course description for APS100H1: Orientation to Engineering

CURRENT course description:
This course is designed to help students transition into first-year engineering studies and to develop and apply a greater understanding of the academic learning environment, the field of engineering, and how the fundamental mathematics and sciences are used in an engineering context. Topics covered include: study skills, time management, problem solving, successful teamwork, effective communications, exam preparation, stress management and wellness, undergraduate research, extra- and co-curricular involvement, engineering disciplines and career opportunities, and applications of math and science in engineering.

PROPOSED course description:
Designed to help students transition into first-year engineering studies, and to develop and

apply a greater understanding of the post-secondary academic learning environment, the field of engineering, application of mathematics and sciences in an engineering context, and properly frame engineering (education) as a socio-technical, people-centred endeavor. Topics include techniques for effective learning, time management, problem solving, successful teamwork, effective communications, test and exam preparation, stress management and wellness, engineering ethics and professionalism, academic integrity and the Student Code of Conduct, applications of math and science in engineering undergraduate research, extra- and co-curricular involvement, and engineering disciplines and career opportunities.

**6.2. CHANGE course description for APS110H1: Engineering Chemistry and Materials Science**

CURRENT course description:
This course is structured around the principle of the structure-property relationship. This relationship refers to an understanding of the microstructure of a solid, that is, the nature of the bonds between atoms and the spatial arrangement of atoms, which permits the explanation of observed behaviour. Observed materials behaviour includes mechanical, electrical, magnetic, optical, and corrosive behaviour. Topics covered in this course include: structure of the atom, models of the atom, electronic configuration, the electromagnetic spectrum, band theory, atomic bonding, optical transparency of solids, magnetic properties, molecular bonding, hybridized orbitals, crystal systems, lattices and structures, crystallographic notation, imperfections in solids, reaction rates, activation energy, solid-state diffusion, materials thermodynamics, free energy, and phase equilibrium.

PROPOSED course description:
The principle of the structure-property relationship refers to an understanding of the microstructure of a solid, that is, the nature of the bonds between atoms and the spatial arrangement of atoms, which permits the explanation of observed behaviour. Observed materials behaviour includes mechanical, electrical, magnetic, optical, and corrosive behaviour. Topics covered in this course include: structure of the atom, models of the atom, electronic configuration, the electromagnetic spectrum, band theory, atomic bonding, optical transparency of solids, magnetic properties, molecular bonding, hybridized orbitals, crystal systems, lattices and structures, crystallographic notation, imperfections in solids, reaction rates, activation energy, solid-state diffusion, materials thermodynamics, free energy, and phase equilibrium.

**6.3. CHANGE course description for APS164H1: Introductory Chemistry from a Materials Perspective**

CURRENT course description:
This online course is structured around the principle of structure-property relationship. This relationship refers to an understanding of the microstructure of a solid, that is, the nature of the bonds between atoms and the spatial arrangement of atoms, which permits the explanation of observed behaviour. Observed materials behaviour includes mechanical, electrical, magnetic, optical, and corrosive behaviour. Topics covered in this course include: structure of the atom, models of the atom, electronic configuration, the electromagnetic

spectrum, band theory, atomic bonding, optical transparency of solids, magnetic properties, molecular bonding, hybridized orbitals, crystal systems, lattices and structures, crystallographic notation, imperfections in solids, reaction rates, activation energy, solid-state diffusion, materials thermodynamics, free energy, and phase equilibrium.

PROPOSED course description:
The principle of structure-property relationship refers to an understanding of the microstructure of a solid, that is, the nature of the bonds between atoms and the spatial arrangement of atoms, which permits the explanation of observed behaviour. Observed materials behaviour includes mechanical, electrical, magnetic, optical, and corrosive behaviour. Topics covered in this course include: structure of the atom, models of the atom, electronic configuration, the electromagnetic spectrum, band theory, atomic bonding, optical transparency of solids, magnetic properties, molecular bonding, hybridized orbitals, crystal systems, lattices and structures, crystallographic notation, imperfections in solids, reaction rates, activation energy, solid-state diffusion, materials thermodynamics, free energy, and phase equilibrium. Online only.

**6.4. CHANGE course description for APS111H1: Engineering Strategies & Practice I**

CURRENT course description:
This course introduces and provides a framework for the design process. Students are introduced to communication as an integral component of engineering practice. The course is a vehicle for understanding problem solving and developing communications skills. This first course in the two Engineering Strategies and Practice course sequence introduces students to the process of engineering design, to strategies for successful teamwork, and to design for human factors, society and the environment. Students write team and individual technical reports.

PROPOSED course description:
An introduction to, and implementation of, a framework for the design process, which is used to teach in context, problem solving, professional communication, and team skills. Students are introduced to design, communication and teamwork as integral and interrelated components of engineering practice. This first course in the two Engineering Strategies and Practice course sequence introduces students to the process of engineering design, including broader considerations, written professional communication, and strategies for successful teamwork. Students will write a series of team and individual engineering reports.

**6.5. CHANGE course description for APS112H1: Engineering Strategies & Practice II**

CURRENT course description:
This course introduces and provides a framework for the design process, problem solving and project management. Students are introduced to communication as an integral component of engineering practice. The course is a vehicle for practicing team skills and developing communications skills. Building on the first course, this second course in the two Engineering Strategies and Practice course sequence introduces students to project management and to

the design process in greater depth. Students work in teams on a term length design project. Students will write a series of technical reports and give a team based design project presentation.

PROPOSED course description:
An introduction to, and implementation of, a framework for the design process, which is used to teach in context, problem solving, professional communication, and team skills. Students are introduced to design, communication, and teamwork as integral and inter-related components of engineering practice. Building on the first course, this second course in the two Engineering Strategies and Practice course sequence introduces students to project management, oral professional communication, and to the design process in greater depth. Students work in teams on a term length design project. Students will write a series of team based and individual engineering reports and give a team based design project oral presentation.

**6.6. CHANGE course description for APS163H1: Calculus for Engineers II**

CURRENT course description:
This online-only course focuses on the fundamental tools of calculus and its connections to engineering. The topics include methods of integration, an introduction to differential equations, series and Taylor series, vector differentiation, and partial differentiation. Problems combining calculus with geometry, linear algebra, statics, and mechanics will be examined.

PROPOSED approved course description:
A focus on the fundamental tools of calculus and its connections to engineering. The topics include methods of integration, an introduction to differential equations, series and Taylor series, parametric and polar curves. Problems combining calculus with geometry, linear algebra, statics, and mechanics will be examined. Online only.

- *Adding parametric and polar curves to the APS163 description is just a "housekeeping item". APS163 has always covered this topic, to mirror the fact that MAT187 is covering the same.*
- *Removing vector-valued functions and partial differentiation is also to mirror the change below for MAT187.*

**6.7. CHANGE course description for APS191H1: Introduction to Engineering**

CURRENT course description:
This is a seminar series that will preview the core fields in Engineering. Each seminar will highlight one of the major areas of Engineering. The format will vary and may include application examples, challenges, case studies, career opportunities, etc. The purpose of the seminar series is to provide first year students with some understanding of the various options within the Faculty to enable them to make educated choices for second year. This course will be offered on a credit/no credit basis.

PROPOSED course description:
A seminar series that previews the core fields in Engineering. Each seminar will highlight one of the major areas of Engineering. The format will vary and may include application examples, challenges, case studies, career opportunities, etc. The seminar provides an opportunity to better understand the various Core 8 programs within the faculty and enable a more educated decision when selecting the program of choice for second year of study. This course is offered on a credit/no credit basis.

### 6.8. CHANGE course description of MAT187H1 – Calculus II

CURRENT course description: Topics include: techniques of integration, an introduction to mathematical modeling with differential equations, infinite sequences and series, Taylor series, parametric and polar curves, vector-valued functions, partial differentiation, and application to mechanics and other engineering problems.

PROPOSED course description: Topics include: techniques of integration, an introduction to mathematical modeling with differential equations, infinite sequences and series, Taylor series, parametric and polar curves, and application to mechanics and other engineering problems.

- *Several programs don't have a particular need for the topics removed, i.e., vector-valued functions and partial differentiation; and for those that do, the students are already learning them in MIE100 in the same term. The suggested change has been discussed in the First Year Core 8 Track One Curriculum Committee in meetings on May 16, 2024 and August 13, 2024. The proposal was generally well-received in that committee and has the support of the First Year Office as well as the Vice Dean, First Year.*

## 7. BIOMEDICAL ENGINEERING

### 7.1. ADD new course BME488 – Introduction to Immunoengineering

PROPOSED course title: BME488 – Introduction to Immunoengineering

PROPOSED year and term: 4$^{th}$ year, Winter

PROPOSED course description:
Immunoengineering is the next frontier in the field of biomedical engineering (BME) where interdisciplinary concepts from material science, synthetic biology, and engineering are used to modulate immune responses. This course will introduce immunoengineering concepts used in the field of vaccines, tolerance, antibody discovery, and adoptive cell transfer therapies.

PROPOSED learning objectives:
i) Understand how engineering principles can be used to study or modulate fundamental

processes in immunology
ii) Exposure to engineering tools applicable for quantitative analyses of immune responses
iii) Familiarity with key scientific articles within the field of immunoengineering

PROPOSED course materials:
Lectures will be based on selected journal articles and supplementary notes while overview of general immunology will draw from the optional textbook.

PROPOSED AUs: 75% Natural Sciences, 25% Eng Sci

PROPOSED timing: Two lectures per week; 1st lecture: 1 hour, 2nd lecture: 2 hours
One tutorial per week for 1 hour. The tutorial will be led by the teaching assistant for the course, who will reiterate and discuss any major concepts covered in lecture as well as be available to answer students' questions.

PROPOSED prerequisites: BME395H1 for EngSci or CHE354H1 for Core 8

PROPOSED exclusions: IMM250H1
PROPOSED Calendar Title : Immunoengineering

**7.2. ADD new course BME466 – Drug Delivery at Biological Barriers and Interfaces**

PROPOSED course title: BME466 – Drug Delivery at Biological Barriers and Interfaces

PROPOSED year and term: 4th year, Winter

PROPOSED course description: The human body is a highly interconnected network of different tissues, and there are all sorts of barriers to getting pharmaceutical drugs to the right place at the right time. In this course, the emphasis is on connecting physiology knowledge with drug delivery techniques and technologies to spark innovative new approaches. Through a combination of lectures, self-paced assignments, and collaborative group discussion, students will engage with their peers to understand course materials (including published literature), explore innovations in drug delivery technologies, and develop the skillset to conceptually design new drug delivery technologies. Modules will include topics around drug delivery and tight junctions, the blood brain barrier, the digestive system, mucous, the immune system and immunogenicity, and intracellular transport. Drug delivery topics such as engineering principles of controlled release, biodistribution, pharmacokinetics, toxicity of biomaterials/ drugs, and immune responses will also be covered.

PROPOSED learning objectives:
1. Demonstrate the knowledge of physiological challenges to drug delivery.
2. Critique existing drug delivery technologies, identifying the challenges they overcome and limitations they still face.
3. Conceptually design new drug delivery technologies based on the topics covered in this

course and propose techniques to test their efficacy.
4. Communicate scientific ideas clearly.
   PROPOSED AUs: 25% Natural Sciences, 50% Eng Sci, 25% Eng Design
   PROPOSED timing**:** 3 lecture hours per week, 1 tutorial hour per week

PROPOSED prerequisites: BME205 or CHE353

PROPOSED exclusions: none

## 8. INSTITUTE FOR STUDIES IN TRANSDISCIPLINARY ENGINEERING EDUCATION & PRACTICE

### 8.1. CHANGE in course description of TEP343H1 - ENGINEERING LEADERSHIP

CURRENT course description:
This course is a practical approach to being a more productive engineer, based on the premise that for technology to become a reality, it must be translated through people. A key is understanding engineers lead in ways that reflect their skills and mind set. The course begins with examining: 1) the meaning of leading (Why do something?); 2) the processes of leading (How do you do you create a vision and motivate others?); and 3) the tools of leading (What steps do you take to lead?). Learning frameworks and personal working styles inventories, provide practical tools to assist the student to understand human nature and the logic of learning, to become a competent leader of self, teams and organizations. The student prepares to become a competent leader by undertaking to learn (understand and integrate) key skills, character attributes and purposeful behaviours. The course presents strategies for development of high-performance teams. Special attention is given to a number of subjects: transformational change, organizational culture, high performance work systems, and self-leadership. The course material is delivered through lectures, readings, in-class discussion and a team project. The project is based on the team interviewing the CEO of an engineering-intensive company or senior leader in the community. Students will be required to submit written reflections on course content and their personal experience.

PROPOSED course description:
Develop a practical approach to being a more productive engineer, based on the premise that for technology to become a reality, it must be translated through people. A key is understanding engineers lead in ways that reflect their skills and mind set. Learning frameworks and personal working styles inventories provide practical tools to assist the student to understand human nature and to become a competent leader of self and of teams. The student prepares to become a competent leader by first developing a deeper understanding of self and then undertaking to learn (understand and integrate) key skills, character attributes, and purposeful behaviours. Strategies for development of high-performance teams are also presented. The material is delivered through lectures, readings, in-class discussion and a team project. Attendance is mandatory to enable learning through experiential activities and critical reflection. The project is based on the team interviewing a

senior leader at an engineering-intensive company or senior leader in the community.

- *Course description is updated to reflect current offering. As more leadership courses have become available at the 400-level this course has converted from being a leadership survey course to a focused self-and team-leadership course focusing on connecting experience to engineering application.*
- *We have added in that "attendance is mandatory" as we have had an increasing number of students in the past few years attempt to double book our course with other "required core courses", sometimes at the recommendation of their academic advisors. We want to put something in the course description that makes it clear that you cannot succeed in this course without attending it and engaging in the learning activities. It is 3 hours a week, to be double booked even for one of those hours means a student would miss 33% of the course. We cannot let that be perceived as OK.*

**8.2. CHANGE in course hours of TEP324H1 – ENGINEERING AND SOCIAL JUSTICE**

CURRENT hours: 2L, 2T per week
PROPOSED hours: 3L per week

- *Students in this class will benefit from a single, longer (3 hour) contiguous, interactive teaching and learning process, rather than two shorter differentiated lecture/tutorial sessions. This course on engineering and social justice is heavily experiential, relies on interpersonal engagement, and works through the collective co-construction of knowledge. It is not enough to learn about the theory or history of social justice; students also need to practice, interpret, and make sense of it in a community. This is easier to do in a 3 hour block than a 2 hour block.*

**8.3. ADD new course TEP435 –THE MEASURE OF ALL THINGS: SENSORS AND DATA FOR SUSTAINABLE DEVELOPMENT**

PROPOSED course title:
TEP435 – THE MEASURE OF ALL THINGS: SENSORS AND DATA FOR SUSTAINABLE DEVELOPMENT

PROPOSED calendar title:
The Measure of All Things: Sensors and data for sustainable development

PROPOSED Calendar Description
We live in a data-driven world, with the total volume of global data projected to be 181 zettabytes by 2025. New ways of measuring and analyzing data in the field of global development are opening the door to a better understanding of global challenges and data-driven innovations have significant economic and societal potential. For example, in the healthcare sector, the use of new devices and analytics can improve diagnosis and triage of disease, improve health system efficiency, and reduce costs. However, there have also been

many instances of sensing technologies and algorithms that perpetuate or enhance inequalities rather than reducing them. Through the use of lectures, case studies, readings, and guest speakers working at the health-water- climate nexus of global challenges, students will learn about innovations in sensing, and data analytics that are helping to advance the UN Sustainable Development Goals. They will learn to analyze and assess historical data and data that is currently being collected in the global development and engineering space and will critically examine examples of biases and flaws with the ways we develop sensors/measurements and train algorithms. Students will have a practical opportunity to develop entrepreneurship skills through proposing and researching a sensing or data analytics innovation for tackling global challenges, developing a business case for this innovation, and pitching their solution to their peers.

PROPOSED Topics Covered

- An introduction to sensing, measurement, and data analytics techniques
- An introduction to bias and discrimination in sensor design, measurement methods, and data analytics, including examples of gender biased and racially biased technologies
- A critical review and discussion of innovative sensors and analytics with a focus on the novel technologies making an impact at the health-water-climate nexus
- An introduction to the principles and challenges of entrepreneurship, with examples of case studies of start-up companies focused on sensors and analytics in global development

PROPOSED Example reference material

- Invisible Women: Exposing data bias in a world designed for men, Caroline Criado Perez
- Race After Technology, Ruha Benjamin
- Beyond Measure: The Hidden History of Measurement from Cubits to Quantum Constants

PROPOSED Methods of Assessment

- Assignment 1 (individual) – Critical analysis using existing data for assessing global challenges
- Assignment 2 (individual) – Sensors and data background research and business model canvas
- Final Project (group) – Sensors and data entrepreneurship pitch and final report
- Participation in class and online discussions
- Final Exam

PROPOSED Delivery: Lectures (3hrs/week), Tutorial (1hr/week)

PROPOSED Offering Term: Fall

PROPOSED Mode of Delivery: In Person

Rationale and Academic Relevance

- *Increasing numbers of engineers are interested in careers as entrepreneurs, particularly in the fields of sensing and data analytics for tackling global challenges like sustainability, access to healthcare and water, and climate change. However, there have been many instances of biased or discriminatory sensing technologies and algorithms that perpetuate or enhance inequalities rather than reducing them. It is essential for engineering students, particularly the increasing number aspiring to be entrepreneurs, to learn to understand and critically analyze decisions about what data is collected and by whom, methods of collecting data, methods for analyzing data, and potential bias at each of these stages. We will examine this through engaging examples of technologies at the health-water-climate nexus of global engineering.*

Overlap of course content with current course offered by other departments/programs

- *There are a couple courses focused on the theoretical and practical aspects of data science and analytics- for example MIE1624 – Introduction to Data Science and Analytics or CSC2537H – Information Visualization. These courses focus on theory and understanding of analytical models and algorithms including data mining and machine learning, with a practical focus on coding (e.g. Python). My course will not delve deeply into practical exercises in data analytics, but will instead encourage critical thought around what data is collected, how, and why.*

- *There is a course in social entrepreneurship (APS1015H) and a course in international business for engineers (APS1020) and two courses in global engineering and technology design in global development (APS 420/1420, and APS530). These courses provide general principles of entrepreneurship/business, the history/context of global development and global engineering, and global engineering design. There is also a course specifically in Innovative Technologies and Organizations in Global Energy Systems (APS510). My course will focus instead on sensing and data analytics for global development, including critical analysis of historical and current data/measurement solutions, and opportunities for entrepreneurship and innovation focused on the health-water-climate nexus.*

# 9. CROSS-DISCIPLINARY PROGRAMS

## 9.1. MINOR IN ADVANCED MANUFACTURING (AEMINADVM)

9.1.1. Add MSE468H1: Additive Manufacturing of Advanced Engineering Materials (new intensive summer course from MSE) as an Advanced elective

- *New course*

9.1.2. Add TEP234H1 Entrepreneurship and Small Business to Requirement 3

- *Additional "leadership, management, business" course option as many of the departments have cancelled their "xxx488H" entrepreneurship courses*

9.1.3. Add MIE464H1 Smart Materials and Manufacturing (new MIE course) to Requirement 2

- *New course*

9.1.4. Add MIE445H1 Design of Effective Products as Advanced elective

- *New course*

**9.2. MINOR IN BIOENGINEERING (AEMINBIO)**

9.2.1. Add BME466H1 – Drug Delivery at Biological Barriers and Interfaces as elective (Cell and Tissue theme)

- *New course*

9.2.2. Add BME488H1 – Fundamentals of Immunoengineering as elective (Cell and Tissue theme)

- *New course*

9.2.3. Add BME520H1 – Imaging Case Studies in Clinical Engineering (Clinical theme)

- *Missed adding this course previously*

**9.3. MINOR IN ENGINEERING BUSINESS (AEMINBUS)**

9.3.1. Add HPS321H1 Understanding Engineering Practice: From Design to Entrepreneurship back as an elective

- *This course was originally designed specifically for the Engineering Business Minor but was unable to be offered for a number of years due to instructor availability. It has now been "reactivated" by IHPST.*

9.3.2. Remove "xxx488" courses that are no longer offered – CIV488/ECE488/MIE488

- *Series of entrepreneurship courses originally created by Joe Paradi, there was one course for each department focused on discipline-specific examples, because he felt students would be more comfortable with a course within their own program code. Only CHE488H1 continues to be offered.*

**9.4. MINOR IN GLOBAL LEADERSHIP (AEMINGLOB)**

9.4.1. Adding TEP435H1 – The Measure of All Things: Sensors and Data for Sustainable Development to List A courses.

- *New course*

9.4.2. Update preamble and Admission criteria

CURRENT entries:
The FASE Minor in Global Leadership is part of U of T's first tri-campus, interdivisional, multidisciplinary undergraduate program. The Minor is distinguished by its critical and multidisciplinary focus on leadership in a global context. This is combined with an emphasis

on developing knowledge of global issues within an engineering framework and how engineers can influence and improve conditions around the world. All undergraduate Engineering students are eligible to participate in this minor course of study, however enrollment is limited. This minor consists of 4.0 FCE, similar to minors from the Faculty of Arts & Science.

Limited Enrolment — Enrolment in this program is limited. Students must follow the appropriate application procedures in the year preceding enrolment. The first application period will be in Spring 2023

PROPOSED entries:
The FASE Minor in Global Leadership is part of U of T's first tri-campus, interdivisional, multidisciplinary undergraduate program. This Minor is distinguished by its critical, multidisciplinary focus on leadership in a global context, combined with an emphasis on developing knowledge of global issues within an engineering framework and how engineers can influence and improve conditions around the world.

Eligibility Requirements: All undergraduate Engineering students who at the time of July course enrollment meet the following criteria:

- First-year undergraduate Engineering students who have completed a minimum of 4.0 FCEs or
- Second-year undergraduate Engineering students who have completed a minimum of 8.0 FCEs, and
- A minimum average GPA of 2.7 across their best 3.0 FCE of courses completed prior to the application deadline
- A minimum of 4 semesters of study remaining to complete core requirements and all necessary electives

- *Updating entry now that program is open. New admissions criteria will allow 2nd year students to apply for admission, which will better fit with our students CS/HSS availability. Students who are admitted to the minor starting in their 3rd year will be expected to take both GLB201H1F and GLBC01H1S in their 3rd year and GLB401Y1Y in their 4th year.*

**9.5. MINOR IN NANOENGINEERING (AEMINNANO)**

9.5.1. Add ECE442H1 F – Introduction to Micro- and Nano-Fabrication Technologies as an Advanced Elective

- *ECE returning this course to its offerings. Previously, this course was the foundational course for the minor, but the minor has since been restructured. We will add the course as an Advanced elective in the minor for now but will reconsider returning it to its role as a foundational course in the future.*

9.5.2. Add MSE466H1 – Practical Aspects of Electron Microscopy

- *New course*

**9.6. CERTIFICATE IN ENTREPRENEURSHIP, INNOVATION AND SMALL BUSINESS (AECERENTR)**

Add APS521H1 – Building Organizations: An Engineer's Business Toolkit

- *The 3rd course of the certificate, TEP432 has not been offered for the last two years and is not likely to be offered next year. APS521 has been approved in both of the last two years as a substitution for students wanting to complete the certificate.*

**9.7. CERTIFICATE IN FORENSIC ENGINEERING (AECERFORE)**

Add AER373H1 - Mechanics of Solid Structures (for Eng Sci students only)

- *Deemed equivalent to other Solids courses already included in the certificate*

**9.8. CERTIFICATE IN GLOBAL ENGINEERING (U of T Global Scholar) (AECERGLOB)**

Add TEP435H1 – The Measure of All Things: Sensors and Data for Sustainable Development to List A courses.

- *New course*

**9.9. CERTIFICATE IN PUBLIC POLICY AND ENGINEERING (AECERPPGE)**

Remove tutorial hour from PPG201H1 in the program table.

- *Tutorial was previously removed from the course in FAS course listing, but not removed from the program table.*

**9.10. APS441H1 - System-Theoretic Accident and Risk Analysis**

- *Approved last year as a new course, the report did not flag that this will be a cross-listed course with APS1101 – System Dynamic Risk Management*

**9.11. FOR427H1 - Working with Wood**

- *Delete – This course was approved as a new course for the Renewable Resources Certificate, but subsequently, DFALD decided to offer it via the Architecture programs instead.*

**9.12. JRE300H1 - Fundamentals of Accounting and Finance**

- *Delivery change from 3/0/1 to 2/2/0.*
- *The Rotman program advisors have proposed to deliver the course in the same format used in JRE410, which includes a 2-hour lecture and a 2-hour practical / tutorial session (2+2) each week. The goal is to make the course more applied to enhance student*

*learning. The course description and learning objectives of the course would not change.*

**9.13. CHANGE course description for JRE410H1 - Markets and Competitive Strategy**

CURRENT course description:
Introduces the basic concepts, frameworks and methodologies useful to managers in crafting and executing entrepreneurial business strategies in technology-based companies. In the first part of the course, students gain an understanding of the external, internal, and dynamic environments of a business and the elements of a superior competitive position. In the second part, we focus on designing and delivering customer value, which involves strategic decisions about segmentation, targeting and positioning, and tactical decisions related to product introductions, marketing communications, distribution channels and pricing. In the third part of the course, we build on these fundamentals and examine challenges related to innovation and industry dynamics, such as industry life cycles, disruptive technologies, product renewal, and the relationship between R&D and commercialization.

PROPOSED course description:
Introduces the basic concepts, frameworks and methodologies useful to managers in crafting and executing entrepreneurial business strategies in technology-based and selected CPG companies. In the first part of the course, students gain an understanding of the external, internal, and dynamic environments of a business and the elements of a superior competitive position. In the second part, we focus on designing and delivering customer value, which involves strategic decisions about segmentation, targeting and positioning, and tactical decisions related to product introductions, marketing communications, distribution channels and pricing. In the third part of the course, we build on these fundamentals and examine considerations related to commercialization, modes to exploit technology/product, intellectual property, and approaches to business start-up.

**9.14. JRE420H1 - People Management and Organizational Behaviour**

CURRENT course description:
Spans three inter-related topics within organizational behavior and human resources: individual behavior, group behaviour, and leadership. It provides students with both the theory and practice of how to work, lead, and thrive in organizations. Topics include theories of personality, learning, power, decision making, ethics, culture, communication, leadership, teamwork, and motivation teamwork. These topics are taught in three ways:

1. Case studies, role play & simulation exercises followed by class discussion
2. Surveys of Personality & Skills
3. Lectures, discussions, and readings based on the current research on the topic

PROPOSED course description:
Spans three inter-related topics within organizational behavior and human resources: individual behavior, group behaviour, and leadership. It provides students with both the theory and practice of how to work, lead, and thrive in organizations. Topics include

theories of personality, learning, power, decision making, ethics, culture, leadership, teamwork, and motivation. These topics are taught in three ways:

1. Case studies, role play & simulation exercises followed by class discussion
2. Surveys of Personality & Skills
3. Lectures, discussions, and readings based on the current research on the topic

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

**Report No. 3772**

# MEMORANDUM

**To:** Executive Committee of Faculty Council (November 19, 2024)
Faculty Council (December 18, 2024)

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

**Date:** October 8, 2024

**Re:** **Inclusion of the Undergraduate Certificate in Electric Vehicle Design and Certificate in Renewable Resources Engineering in the U of T Sustainability Scholar Program**

## REPORT CLASSIFICATION

This is a routine or minor policy matter that will be considered by the Executive Committee for approving and forwarding to Faculty Council for information.

## BACKGROUND

The University of Toronto Sustainable Scholar Working Group was created out of the President's Advisory Committee on the Environment, Climate Change and Sustainability. The intent of the working group is to enhance programming in sustainability for the university as a whole. As part of this, they proposed to create the U of T Sustainability Scholars program, a U of T transcript recognition similar to that which was recently created for the U of T Global Scholars program, to recognize students pursuing studies in the area of sustainability.

The Faculty's existing undergraduate minors in Sustainable Energy and Environmental Engineering, offered through the Cross-Disciplinary Programs Office, were added to this program in 2020. Recently the Advisory Committee identified two of our certificates as appropriate programs for inclusion in this initiative as well.

## PROPOSED CHANGES

In order to add these certificate programs to the Sustainability Scholars program, the title of the certificates in the calendar entry and the notation on students' transcripts will now read "Certificate in Electric Vehicle Design (U of T Sustainability Scholar)" and "Certificate in Renewable Resources Engineering (U of T Sustainability Scholar)." Revised calendar entries are shown below.

**EFFECTIVE DATE**

The new titles and transcript notations will be effective starting September 2025.

**CALENDAR ENTRIES**

1) The calendar entry for the Certificate in Electric Vehicle Design will now read as follows (updates are in red):

**Certificate in Electric Vehicle Design (U of T Sustainability Scholar) – AECEREVD**

Electrifying the transportation sector is one of the major priorities to reach Net Zero emissions. The transition to electric vehicles (EVs) in the automotive sector is the largest technology shift in over 100 years. A new generation of skilled engineers is needed to address the cross-disciplinary challenges in the growing EV sector.

This certificate provides an opportunity for students to learn about EVs within the context of engineering applications and expand their understanding of the technical and environmental implications of engineering in EV design.

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 and are considered University of Toronto Sustainability Scholars.

2) The calendar entry for the Certificate in Renewable Resources Engineering will now read as follows:

**Certificate in Renewable Resources Engineering (U of T Sustainability Scholar) – AECERRRE**

Successful completion of an Engineering Certificate is included on transcripts. Note that no course counted for degree credit, can be counted for more than one minor or certificate.

The Forestry faculty at the John H. Daniels Faculty of Architecture, Landscape, and Design have expertise in sustainable resource management and bio-economics, sustainable energy production, green manufacturing and sustainable communities. This grouping of courses developed for engineering students reflects the strong interconnections between their work and various branches of engineering. The certificate provides recognition for a demonstrated focus in renewable resources. Students in all disciplines are eligible to participate in this certificate. Students who complete the requirements of the Certificate in Renewable Resources Engineering are considered University of Toronto Sustainability Scholars.

**CONSULTATION**

The title and transcript notation changes were discussed and endorsed by the Undergraduate Curriculum Committee. Faculty members associated with the certificates at FASE and DFALD were also consulted.

**RECOMMENDATION FOR FACULTY COUNCIL**

For information.

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

**Report No. 3774**

# MEMORANDUM

To: Executive Committee of Faculty Council (November 19, 2024)
Faculty Council (December 18, 2024)

From: Prof. Alan Chong
Chair, Undergraduate Admissions Committee

Date: November 4, 2024

**Item: Admissions Cycle 2024**

## REPORT CLASSIFICATION

This is a routine or minor policy matter that will be considered by the Executive Committee for approving and forwarding to Faculty Council for information.

## 2024 ADMISSIONS CYCLE

This report will provide a summary of the activities of the Undergraduate Admissions Committee for the period November 1, 2023 to November 1, 2024.

## RECOMMENDATION FOR COUNCIL

For information.

### Applications for Admissions

| Year | 2021 | | 2022 | | 2023 | | 2024 | |
|---|---|---|---|---|---|---|---|---|
| Total Applications | 13188 | | 13454 | | 13592 | | 14876 | |
| Female Applicants | 3272 | 25% | 3493 | 26% | 3568 | 26% | 3997 | 27% |
| Ontario Secondary School (OSS) Applications | 6207 | 47% | 6776 | 50% | 6989 | 51% | 7870 | 53% |
| Non-OSS Applications | 6981 | 53% | 6778 | 50% | 6601 | 49% | 7006 | 47% |
| Domestic Applicants | 7927 | 60% | 8803 | 65% | 9107 | 67% | 10284 | 69% |
| International Applicants | 5261 | 40% | 4651 | 34% | 4485 | 33% | 4592 | 31% |

## Offers of Admission

| Year | 2021 | | 2022 | | 2023 | | 2024 | |
|---|---|---|---|---|---|---|---|---|
| Total Offers | 4298 | | 4447 | | 4640 | | 4826 | |
| Female Offers | 1688 | 39% | 1719 | 39% | 1770 | 38% | 1875 | 38% |
| OSS Offers | 2307 | 54% | 2255 | 51% | 2328 | 50% | 2319 | 48% |
| Non-OSS Offers | 1991 | 46% | 2192 | 49% | 2312 | 50% | 2507 | 52% |
| Domestic Offers | 2695 | 63% | 2786 | 63% | 2808 | 61% | 2720 | 56% |
| International Offers | 1601 | 37% | 1661 | 37% | 1832 | 40% | 2106 | 44% |

## Registration Figures

| Year | 2021 | | 2022 | | 2023 | | 2024 | |
|---|---|---|---|---|---|---|---|---|
| Registered as of Nov. 1* | 1279 | | 1284 | | 1373 | | 1324 | |
| Female Registered | 491 | 38% | 519 | 40% | 519 | 38% | 520 | 39% |
| OSS Registered | 750 | 59% | 735 | 58% | 832 | 61% | 834 | 63% |
| non-OSS Registered | 516 | 40% | 541 | 42% | 541 | 39% | 490 | 37% |
| Domestic Registered | 887 | 69% | 910 | 71% | 950 | 69% | 947 | 71% |
| Int'l Registered | 392 | 31% | 374 | 29% | 423 | 31% | 377 | 29% |
| IFP degree studies** | 13 | | 6 | | 4 | | NA | |
| Nov 1 Target | 1176 | | 1183 | | 1235 | | 1250 | |

*includes newly admitted first year, upper year students and IFP students entering degree study

**Reflects students who have successfully completed IFP and began degree studies as of September 2024. September 2023 was the final IFP incoming class.

## Characteristics of the First Year Class 2024

| Programs | FT | PT | Total | NON-OSS | OSS | # Women^ | % Women | Domestic | Int'l | Mean OSS Avg |
|---|---|---|---|---|---|---|---|---|---|---|
| Chemical | 154 | | 154 | 50 | 104 | 68 | 44% | 118 | 36 | 92.7 |
| Civil | 141 | 1 | 142 | 52 | 90 | 49 | 35% | 112 | 30 | 93.1 |
| Computer | 164 | | 164 | 67 | 97 | 65 | 40% | 111 | 53 | 96.7 |
| Electrical | 121 | | 121 | 45 | 76 | 41 | 34% | 74 | 47 | 96.2 |
| Track One | 116 | | 116 | 49 | 67 | 45 | 39% | 78 | 38 | 95.7 |
| EngSci | 270 | | 270 | 87 | 183 | 113 | 42% | 195 | 75 | 97.0 |
| Industrial | 84 | 1 | 85 | 46 | 39 | 41 | 48% | 54 | 31 | 94.9 |
| Mineral | 51 | 2 | 53 | 18 | 35 | 10 | 19% | 45 | 8 | 89.1 |
| Mechanical | 161 | | 161 | 50 | 111 | 74 | 46% | 126 | 35 | 95.7 |
| Materials | 57 | 1 | 58 | 26 | 32 | 14 | 24% | 34 | 24 | 93.3 |
| Total | 1319 | 5 | 1324 | 490 | 834 | 520 | 39% | 947 | 377 | 95.1 |

* New first year students only.

** Based on final grades in six courses required for admission, including Chemistry, Advanced Functions, Calculus & Vectors, Physics, English and one additional subject. These averages differ from the values used for admission decisions, which are based on interim grades without inclusion of the sixth subject.

^ For 2024 admissions, the OUAC allowed additional gender categories. Women includes students self-reporting as 'female' and 'trans-woman'

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

**Report No. 3775**

# MEMORANDUM

**To:** Executive Committee of Faculty Council (November 19, 2024)
Faculty Council (December 18 2024)

**From:** Professor Alan Chong
Chair, Admissions Committee

**Date:** November 4, 2024

**Re: Pilot of Chemistry Requirement Change for A-level applicants**

## REPORT CLASSIFICATION

This is a routine or minor policy matter that will be considered by the Executive Committee for approving and forwarding to Faculty Council to receive for information.

## BACKGROUND

Students that follow the British-patterned GCE A-level education system will take the IGCSE/GCE/O-level board examination in Year 11 (equivalent to Grade 10 in Ontario), AS-level board examination in Year 12 (i.e. Grade 11), and A-level in Year 13 (i.e. Grade 12). For some of these students, depending on the region and their high schools, they will take IGCSE/GCE/O-level board exam in Year 11, skip AS-level in Year 12, and take A-levels in Year 13.

Our application requirements for British-patterned GCE A-level education system applicants require them to present at least AS-level Chemistry. Every year, we receive a number of quality applicants that did not present at least AS-level Chemistry but meet our competitive requirements otherwise. Departments have chosen to admit them with the condition that they present Ontario Grade 12 Chemistry prior to the start of Fall term to align with our overall admission requirement standards (i.e., applicants from each education system are required to present the highest level of pre-requisites offered in their education system). This past cycle, we offered 20 such applicants. Unfortunately, the yield of these applicants was 0. It came as a no surprise that these candidates decided to decline our offer as they would have received offers from other institutions without the need to complete the Ontario Grade 12 Chemistry requirement.

Taking a more comprehensive environmental scan of admission requirements to other Engineering programs in Canada (e.g., University of Waterloo, Queen's, McMaster University, University of British Columbia, McGill, Western University and University of Calgary), we noted that these universities' minimum Chemistry requirement is GCE O-level Chemistry.

Researching further into overseas institutions in the U.K. (e.g., University of Cambridge, University of Oxford, University College London) and U.S. (e.g., U.C. Berkeley, University of Michigan, Princeton, Columbia University, UCLA, etc.), we noted that U.K. engineering schools do not require Chemistry as an admission pre-requisite, and the U.S. institutions accept GCE O-level Chemistry as a minimum.

Of course, an argument could be made that each engineering school might structure their curriculum differently – thus relying on different high school pre-requisites to serve as foundation. For instance, they may not have an engineering-specific Chemistry course in Year 1 (as we do), and hence, the lower requirement on Chemistry at admissions. In addition, some schools could do a general first year to catch students up to speed on the required level of academic foundation to proceed to upper years.

In view of the above, we reviewed the curriculum offered under IGCSE/GCE/O-level Chemistry and found that coverage to be comprehensive and on par with the content covered in Ontario Grade 12 Chemistry (i.e., there is no significant content missing if an applicant were to be admitted with just O-level Chemistry compared to an Ontario high school admit).

Furthermore, students following the British-patterned A-level education system do not have the same flexibility afforded to Canadian high school students where they could easily pick up a summer class in high school or night school if they realize they are missing a university admission pre-requisite by the time they are in final year of high school. The courses that students take in A-levels are determined at the end of Year 11 (i.e., Grade 10), with no bandwidth to take courses beyond what they have planned for. Unfortunately, most Grade 10 students are not thinking about university admission requirements just yet, or they might assume having math and physics would meet the academic requirements.

We propose to offer admissions to candidates that only have IGCSE/GCE/O-level Chemistry without the condition that they present Ontario Grade 12 Chemistry. **This will be a time limited pilot for up to a maximum of four years.** Candidates admitted with just O-level Chemistry will be tracked on a semi-annual basis, and data will be shared with the Undergraduate Admissions Committee.

For departments that wish to admit candidates with a higher level of Chemistry (i.e. at least AS-level Chemistry), they can certainly choose to do so and refuse/pass on candidates that only present O-level Chemistry.

**PROPOSED**

Current A-level application requirements:

- Math – A-level
- Physics – A-level
- Chemistry – A-level or AS-level
- A third A-level subject is required if Chemistry is only presented at the AS-level.

The pilot proposal:

- Math – A-level
- Physics – A-level
- Chemistry – A-level, AS-level or O-level
- A third A-level subject is required if Chemistry is only presented at the AS- or O-level.

**CONSULTATION PROCESS**

The pilot proposal was first brought forward to the Undergraduate Admissions Committee on June 21, 2024. Preliminary discussions were had by the committee members.

We then moved forward with individual departmental consultation that involved the departmental representatives that sat on the Undergraduate Admissions Committee, and/or department chairs during late-August to early October.

The Undergraduate Admissions Committee met on October 25, 2024 to report on Fall 2024 numbers and revisited the above proposed pilot study. Voting members voted unanimously to move forward with such a pilot proposal.

**RECOMMENDATION FOR COUNCIL**

For information.

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

**Report No. 3776**

# MEMORANDUM

**To:** Executive Committee of Faculty Council (November 19, 2024)
Faculty Council (December 18, 2024)

**From:** Professor Lisa Romkey
Chair, Engineering Graduate Education Committee

**Date:** November 8, 2024

**Re:** **Engineering Graduate Education Committee Update**

## REPORT CLASSIFICATION

This is a routine or minor policy matter that will be considered by the Executive Committee for approving and forwarding to Faculty Council to receive for information.

## MINOR MODIFICATION

The following modifications to the Graduate Emphasis in Robotics were approved by the Engineering Graduate Education Committee

| | |
|---|---|
| **Emphasis in Robotics** | 1. As a result of the creation of the Collaborative Specialization in Robotics in 2022, the Emphasis in Robotics was closed to MASc and PhD students, remaining open only to MEng students. It is proposed that the emphasis' admission requirements be updated to reflect this.<br>2. Expansion of elective course list (see Appendix 1). |

## NEW COURSES APPROVED

The following new courses have been approved by the Engineering Graduate Education Committee:

| | |
|---|---|
| AER1405H: Metamaterials for Aerospace Applications | This course focuses on the properties, design, and manufacturing of metamaterials in the context of aerospace structures. Metamaterials (also called architectured materials or materials-by-design) are materials with carefully designed meso- and micro-structures to achieve macroscopic properties which are not typically observed in conventional engineering materials. Therefore, the geometry of metamaterials directly influences their properties, rather than their compositions, as found, for example, in typical alloy systems.<br><br>Metamaterials are often characterized by a spatial symmetry. The most well-known category of metamaterials are truss structures in bridge and tower structures in civil engineering. Advances in additive manufacturing enabled the design and manufacturing of these truss networks on the meso-and micro-scale. They combine desirable mechanical properties, e.g., high stiffness, high strength, and high fracture toughness, while still maintaining a low density. This unique combination of mechanical properties creates highly sought-after materials for aerospace applications, such as stiffening components in reusable rockets, high-toughness aircraft fuselages, or zero thermal expansion structures in satellites. Other classes of metamaterials will be briefly explored in this course, which combine beneficial mechanical properties with e.g. the capability of manipulating electromagnetic waves (blocking wave-propagation, embedding sensors, or tailoring the sound propagation). Finally, novel classes of metamaterials will be discussed in this course, e.g. active materials and design for self-assembly. |
| APS1090H: Risk Engineering | Insurance has enabled each major socioeconomic transition over the last 600 years, whether underwriting shipping in the early days of international trade, to the introduction of machines, to advances in healthcare to capital infrastructure development. In the same way and at a much smaller scale, it allows entrepreneurs to secure loans, households to survive the accidental loss of a critical asset like a house or car, and manufacturers to retool and shift production. While each situation has a unique risk profile, there are four broad approaches to managing commercial risks. These range from the prescriptive practice most commonly associated with FMGlobal, to the incentivized actions such as FireSmart and Home Improvement, to generalized advice on risk & resilience such as the BOMA Canada guide, to a fully integrated corporate risk management regime. Assessing the risks for underwriting will follow either a quality assurance or quality control approach. |

| | |
|---|---|
| BME1455H: Microfluidics for Bioanalytical Research | Microfluidic devices leverage special properties of fluids at micron-scales to provide precise control over fluids and samples inside microfluidic channels. Inside microfluidic devices, fluids are highly predictable and controllable, making them versatile tools for biotechnology and biological research. This course will provide students with a foundational intuitive understanding of fluidic phenomena at the micron scale, microfluidic devices, how they are made, and their applications for bioanalytical research of biomolecular and cellular systems, including single-cell assays, immunological, and biochemical assays. |
| BME1530H: Robot Foundations & Programming for Biomedical Applications | The global medical robot market is valued over $20 billion and is in the same ballpark as other robot market sizes (e.g. industrial, household). With a current annual growth rate over 15%, medical robots will help to bridge lack of skilled professionals in the healthcare sector. Through this course, engineering students will be prepared interacting with robots and develop future innovations in biomedical robotics.<br><br>The course covers the foundations of robotics for biomedical engineering. Students will learn about applications that range from biomedical lab automation, robot-assisted surgery, mobile and service robots in hospitals, as well as further smart robot types for healthcare purposes. The practical component of the course will allow students to interact and program collaborative robots in UTM's Robot Teaching Lab. Students will learn foundational concepts of robotics, i.e. forward and inverse kinematics, dynamics, trajectory generation, motion planning and execution for serial robots. Further on, they will learn to program robot motions in a preplanned, teleoperated and collaborative robot-style fashion. They will be familiarized with state-of-the-art methods like active constraints, admittance control, as well as coordinate system transformations through point-based and image-to-physical registration. In their course project, students have the chance to develop a robot application that is centered around their own research project, towards a lab automation task or hard- and software extensions ranging from designing dedicated end effectors, integrating sensors, or developing AI-based control methods. |
| CIV1251H: Introduction to Corrosion | This course will provide students with the understanding of basic science of corrosion and the tools used to predict corrosion behaviour in practice, selection of appropriate corrosion resistant materials for an application, and the analysis of corrosion failure in various engineering sectors. There will be several industry leaders joining us to talk about their specialized topics. This course will answer corrosion-related questions, including: (i) what is the worldly impact of corrosion-affected structures? (ii) what is the probability of corrosion occurrence in certain structures and designs? (iii) what forms of corrosion exist on |

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| | a particular structure and how do we prioritize their solutions? (iv) how fast will structures deteriorate due to corrosion? (v) what destructive and non-destructive methods are used to characterize/test corrosion in the laboratory and field? and (vi) How do we protect against corrosion in newly built structures (i.e. material selection, optimized designs with sustainability, safety, and economic considerations, etc.). Although the course is aimed at civil engineering structures (e.g. reinforced concrete structures affected by corrosion due to exposure in marine and inland environment), many concepts and case-studies provided are applicable to corrosion-affected structures in other industries (e.g. automotive, aerospace, nuclear, biomedical, etc.) |
| CIV1284H: Introduction to Construction Claims | In this course, students study advanced topics in construction contracting. It is a follow-up to CIV1279, which provides a general introduction to contract documents. The course specifically focuses on the claims and alternative dispute resolution processes. The complexity of todays' contracts and the increasing dynamics of project scope and work plans can result in change orders and/or conflicts between project stakeholders—typically between the owner and the contractor. In this course, students study means to reduce conflict and claims through designing protocols for tracking project scope changes; evaluation of the conditions under which to file a claim (form the contractor perspective); and assess means to evaluate the merit of a claim (from the owner perspective). Because claims could be contentious, industry best practices have evolved to seek alternative mean to resolve conflicts in project plans. The students will compare alternatives for reducing conflicts and resolving claims, including their applicability to various project conditions, and how to manage an alternative dispute resolution process. |
| CIV1410H: Rock Engineering Design Practice | This course addresses practical considerations in the analysis and design of surface and underground excavations in rock. Topics covered include: Practical Rock Engineering Problems; Rock Mass Characterization; Rock Mass Classification; Rock Mass Failure Mechanisms; The Art of Rock Engineering Design; Ground Support Technology; Tunneling in Rock; Long Term Performance of Excavations; Forensic Investigations; Case studies in Rock Slope Engineering. Underground Excavations in Rock and Deep and High Stress Conditions. |
| ECE1257H: Integral Equation Methods for Computational Electromagnetism | Computational electromagnetism plays a crucial role in many areas of scientific research and industrial applications, including antennas, radar, metamaterials, integrated circuit design, quantum computing, energy generation and transmission, optics, medical imaging, sensing, radioastronomy. This course focuses on integral equation methods for solving Maxwell's equations, covering theory, implementation, applications and recent research developments. |

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| | Electrostatic problems are first used to introduce students to fundamental concepts: integral formulations of Maxwell's equations, the Green's function, discretization and testing aspects, computation of singular integrals. After a review of direct and iterative methods to solve linear systems, we discuss the most prominent techniques for accelerating integral equation. methods, including fast multipole algorithms, FFT-based approaches, and hierarchical matrices. The general case of electrodynamics is considered next, including the choice of basis functions, modeling of excitations, postprocessing of results, modeling penetrable objects. Finally, selected topics from recent research will be presented.<br><br>Throughout the course, examples drawn from real applications will be presented, related to integrated circuit design, antenna modeling, and metamaterials. The course engages students in lectures with an active, hands-on approach based on learning notebooks that both exemplify the concepts covered in lectures, as well as require students to immediately put them into practice. Students will be required to solve 3-4 assignments and work on a final project, typically related to their research interests. The project deliverables will be: an IEEE- formatted report, a presentation, and the submission of the developed codes. |
| MIE1630H: Reinforcement Learning for Research | This course is to provide fundamental concepts and mathematical frameworks for reinforcement learning. Specific topics include Markov decision processes, tabular reinforcement learning, policy gradient methods, function approximation and model-based methods. The course is technical and intended for advanced students with a strong mathematical background and programming skills. Emphasis will be placed on recent developments and principled approaches. |
| MIE 1632H: Symbolic AI Methods for Combinatorial Optimization | Combinatorial optimization problems consist of making a set of discrete but inter-related decisions to optimize some objective function. While such problems are economically important across many industries and services, they also grow exponentially in difficulty with problem size. Thus there exists a substantial literature on the theory and practice of combinatorial problem solving with Artificial Intelligence (AI) and Operations Research (OR). This course will provide students with advanced conceptual, theoretical, and implementational knowledge and skills for modeling and solving such problems. The course will cover the fundamental components of developing mathematical models within existing AI frameworks of SAT, Constraint Programming, AI planning, and Domain-Independent Dynamic Programming while also teaching the fundamental mathematics and algorithms with which the frameworks solve the problem thus modeled. Basic knowledge of symbolic AI approaches as typically taught in undergraduate courses as well as a familiarity with computational complexity is recommended. Knowledge of Operations |

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| | Research approaches to combinatorial optimization is an asset. |
| MSE1003H: Advanced A.I. for Accelerated Materials Discovery | This course delves into the cutting-edge field of AI-driven materials discovery, equipping students with the tools to develop advanced algorithms that can autonomously learn from data, make predictions, and direct future experiments. Students will explore how AI models such as decision trees, Bayesian optimization, and other statistical methods can be combined with adaptive strategies to propose new experiments and calculations in an iterative loop. This hands-on course emphasizes the design and implementation of AI optimization workflows. Students will practice balancing exploration and exploitation strategies, as well as design their own. The course culminates in a final project where students will deploy their workflows to control a self-driving lab, guiding an autonomous materials optimization campaign. |
| MSE1059H: Synthesis of Nanostructured Materials | This course offers an overview of synthesis techniques to produce various nanostructured materials, including quantum dots, carbon-based nanomaterials, metal-based nanomaterials, metal oxide nanomaterials, and superlattice nanocomposites. These synthesis techniques are categorized into chemical methods and physical methods. The chemical methods module discusses the general principles of nucleation and growth, as well as specific nanomaterial synthesis by reductions, calcination, precipitation, micelles, ion-exchange, sol-gel, electrochemical methods, etc. The physical methods module introduces various nanomaterials synthesis by solid-state processing, liquid phase processing, vapour phase processing, etc. In addition, this course also introduces the nanomaterial development, the fundamental properties of nanomaterials (i.e., quantum confinement, surface effect, Brownian motion, electric double layer, etc.), and the basic solid-state physics for nanocrystalline materials (i.e., crystallography, defect structures, etc.). Advanced technologies for the material characterizations (i.e., XRD, TEM, SEM, EDS, XPS, DLS, etc.) are also discussed, particularly with specific examples of their applications for nanomaterials. |
| MSE1070H: Biomedical and Clinical Devices | This course provides an opportunity for students to study current health issues directly from local clinical and industry guest lecturers. Students will broaden their understanding and knowledge of medical problems based on body site (e.g., the heart, vascular system, and brain) and apply their engineering background to propose solutions (e.g., a new biomedical device, biomaterial, etc.). Students will also learn the process behind developing biomedical devices from ideation to commercial release. The format is interactive with students and faculty, with student groups preparing proposed solutions, presented in class, and receiving real-time feedback. |

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| TEP1440H: To Engineer is Human: Human Interaction Dynamics and Social Context in Engineering Work | Behind every engineering feat is a human story. Students will learn to examine this often-overlooked perspective of engineering and its implications for engineering work. Engineering is at its core a human activity geared at helping to attain human goals, which requires the integration of many viewpoints, technical and non-technical. Drawing on perspectives from humanities and social science disciplines (e.g., sociology, anthropology, psychology, history, and political science) students will explore aspects of the human condition as it relates to engineering work: particularly the complexity of individuals, the contexts in which they operate, and how this shapes collaborative work. They will develop an appreciation for and skills to engage in the interdisciplinary work that engineering entails by examining conceptions of engineering, as well as the humanities and social sciences, and their intersections with engineering. Students will integrate these themes in projects that investigate the human stories behind various technologies. |

**COURSE MODIFICATIONS**

The following courses have had minor modifications approved by the Engineering Graduate Education Committee:

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| APS1101H: System-Theoretic Accident and Risk Analysis | Course name changed from “System Dynamic Risk Assessment” to “System-Theoretic Accident and Risk Analysis” to reflect course content. |
| CHE1152H: Membrane Engineering | Minor updates to course description, assessment and topics.<br>Revised course description: Membranes are essential components in energy-efficient industrial separations (e.g., reverse osmosis, ultrafiltration, gas separations, electrodialysis) and electrochemical devices (e.g., electrolyzers, fuel cells, batteries). This course focuses on the fundamentals of membrane science, as relevant for industrial separations and electrochemical devices. Electrolyte systems are relatively emphasized. The course discusses transport of solvents (e.g., water), solutes, and ions in membranes; polymer chemistry, membrane synthesis, and membrane morphology; and details and requirements of specific applications. The course is relevant for water treatment, mining and metals, chemical processing, and electrochemical engineering. |
| MIE1721H: Reliability and Asset Management | Change is the amalgamation of MIE1723 and MIE1721 (MIE1723 is no longer running with this change).<br>Revised course description: The goal of the course is to introduce students |

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| | to principles of reliability from a practical point of view. The course covers principles of quality, principles of reliability, reliability of systems, failure rate data and models, quality and reliability in design and manufacturing, and reliability and availability in maintenance including cost models. Determination of optimal maintenance and replacement practices for components and capital equipment, including preventive maintenance policies and inspection policies are covered. A moderate knowledge of probability and statistics is a requirement. |

**RECOMMENDATION FOR COUNCIL**

For information.

# University of Toronto
# Minor Modification Proposal

## Change to an Existing Graduate Program or Collaborative Specialization

This template was developed by the Office of the Vice-Provost, Academic Programs and updated on March 6, 2018. It should be used to bring forward all proposals for minor modifications to program or admissions requirements for existing graduate programs or collaborative specializations under the University of Toronto's Quality Assurance Process.

| | |
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| Program/Collaborative Specialization being modified: | MEng, Emphasis in Robotics |
| Graduate unit: | Mechanical & Industrial Engineering (MIE)<br>Electrical & Computer Engineering (ECE)<br>University of Toronto Institute for Aerospace Studies (UTIAS) |
| Faculty/academic division: | Faculty of Applied Science & Engineering (FASE) |
| Dean's Office contact: | Prof. Julie Audet, Vice-Dean Graduate Studies<br>Caroline Ziegler, Governance & Programs Officer |
| Version date: | September 24, 2024 |

## 1. Summary

- *Check box for type(s) of change.*
- *Summarize what the change is, including details about any changes to FCEs.*

| | | | |
|---|---|---|---|
| X | Changing admission requirements | | Renaming field, concentration or emphasis* |
| X | Changing program requirements | | Renaming of program or collaborative specialization (please notify VPAP before governance) |
| | Changing timing of program requirements | | Creating a new emphasis |
| | | | Changes to programs affecting an MOA |

* Anything with a changed/new name requires consultation with VPAP Office prior to governance; if name change implies significant change to what is being offered or how it is being offered, this may be a major modification or new program.

This proposal covers two changes:

1. As a result of the creation of the Collaborative Specialization in Robotics in 2022, the Emphasis in Robotics was closed to MASc and PhD students, remaining open only to MEng students. It is proposed that the emphasis' admission requirements be updated to reflect this.
2. Expansion of course options: expand the list of eligible courses to include existing pre-approved substitutions to reflect the increase in new robotics and robotics-related course offerings. This includes:
    - ECE 1635 – Special Topics in Control I
    - ECE 1505 – Convex Optimization
    - ECE 1513 – Intro to Machine Learning
    - ECE 1508 – Special Topics in Communications: Applied Deep Learning
    - ECE 1508 – Special Topics in Communications: Reinforcement Learning
    - MIE 1517 – Introduction to Deep Learning
    - MIE 1077 – Artificial Intelligence for Robotics III (AIR III): Advanced AI-Based Robot Applications
    - MIE 1076 – AI Applications in Robotics II
    - MIE 1080 – Introduction to Healthcare Robotics
    - MIE 1050 – Design of Intelligent Sensor Networks
    - CSC 2606 – Continuum Robotics
    - CSC 2626 – Imitation Learning for Robotics
    - STA 2104 – Statistical Methods for Machine Learning II

## 2. Effective Date of Change

January 2025

## 3. Academic Rationale

- *State academic reasons for the change(s).*

The Institute for Robotics & Mechatronics (currently known as the University of Toronto Robotics Institute) was formed in 2010 as an EDU:C to unite robotics research and launch undergraduate and graduate robotics training options within the Faculty. The institute subsequently helped launch and supports the Engineering Science Major in Robotics Engineering, the undergraduate Minor in Robotics & Mechatronics, and the graduate Emphasis in Robotics.

The emphasis was initially open to MEng, MASc and PhD students in Aerospace Engineering, Electrical and Computer Engineering, and Mechanical and Industrial Engineering. However, in 2022 a proposal to establish a Collaborative Specialization in Robotics was approved. The collaborative specialization, created with the support of the University of

Toronto Robotics Institute, is available to MASc and PhD students in FASE, the Faculty of Arts & Science, the Temerty Faculty of Medicine, and the University of Toronto Mississauga.

The collaborative specialization is meant to complement the Emphasis in Robotics, which remains available in FASE only to MEng students. It is proposed that the emphasis' admission requirements be updated accordingly.

Re. the expansion of course offerings, Robotics is a growing and highly interdisciplinary field with courses offered across multiple departments including MIE, ECE and UTIAS. By adding pre-approved course substitutions to the approved course list, the emphasis will better reflect the increase in robotics course offerings and the growth of robotics at U of T. It will also reduce admin time for faculty and staff who receive and manage requests from students about course substitutions.

## 4. Impact on Students

- *Outline the expected impact on continuing and incoming students, if any, and how they will be accommodated.*

The creation of the Collaborative Specialization in Robotics in 2020 has had minimal impact on enrolment in the emphasis and no effect on FASE MEng students.

MASc and PhD students who were enrolled in the emphasis when the collaborative specialization was created are still eligible to complete it. Since 2020, MASc and PhD students who are interested in the emphasis have been directed to the collaborative specialization.

Re. the course list update, currently, students are limited by requesting only one substitution, whether from a pre-approved list or on a case-by-case basis. By updating the approved course list with pre-approved substitutions, students can better take advantage of the range of robotics courses offered at U of T, broaden their application and understanding of this interdisciplinary field, and take more courses aligned with their interests. It will also improve clarity for students about course requirements.

This change is not anticipated to impact current or incoming students other than providing more course options that can be counted towards their emphasis requirements.

## 5. Consultation

- *Describe any consultation undertaken with the students, faculty, Dean and chair/director. Address any major issues discussed.*

The proposal to create the Collaborative Specialization in Robotics, with the intention to restrict the Emphasis in Robotics in FASE to MEng students only, underwent wide consultations and

was supported by students, faculty, stakeholders and academic leadership within Dean's Office, UTIAS and affected Faculties.

Graduate studies chairs noted that spaces in some courses may be limited for MEng students depending on the department they are enrolled in. We will ensure MEng students are aware of this by including the following disclaimer on the Robotics Emphasis webpage:

*Important note about course registration: if you are not enrolled in the department offering the course(s) you are interested in, some courses may reach their registration cap due to limited seats open to students outside the department. For questions about enrollment, please contact your department graduate advisor.*

The course list was circulated to department graduate studies chairs for consideration and approval. This included:

- ECE – Antonio Liscidini
- MIE – Eric Diller
- UTIAS – Chris Damaren
- CompSci – Faith Ellen
- Statistical Sciences – Stanislav Volgushev

## 6. Resources

- *Describe any resource implications of the change(s) including, but not limited to, faculty complement, space, libraries and enrolment/admissions).*

There are no resource implications associated with these changes.

## 7. Governance Approval

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| University of Toronto Institute for Aerospace Studies (UTIAS) sign-off | Sept 2024 |
| Engineering Graduate Education Committee (EGEC) approval | |
| Council of the Faculty of Applied Science & Engineering (FASE) approval | Dec 18, 2024 |

## 8. Appendix A: Calendar Entry

- *Changed text is indicated in red.*

**Emphasis: Robotics (MEng only)** [Note: This change is reflected in the 2023-2024 SGS calendar.]

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), ECE1635H, ECE1636H, ECE1647H, ECE1653H, ECE1657H,
MIE1064H.

### Group 2: Perception and Learning

AER1513H, AER1515H,
CSC2503H, CSC2506H, CSC2515H, CSC2541H, CSC2548H, **CSC2626H**
ECE516H, **ECE1508H**, ECE1511H, ECE1512H, **ECE1513H**
JEB1433H,
**MIE1076H, MIE1077H, MIE1517H,**
ROB501H,
**STA2101H**.

### Group 3: Modelling and Dynamics

AER506H, AER1503H, AER1512H,
JEB1444H
**ECE1505H**
MIE1001H

### Group 4: Systems Design and Integration

AER525H (exclusion: ECE470H), AER1216H, AER1217H
**CSC2606H**, CSC2621H,
ECE470H (exclusion: AER525H)
MIE505H, MIE506H, **MIE1050H**, MIE1070H, MIE1075H, MIE1076H, MIE1080H, MIE1809H,
ROB521H, ROB1514H

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

**Report No. 3778**

# MEMORANDUM

**To:** Executive Committee of Faculty Council (November 19, 2024)
Faculty Council (December 18, 2024)

**From:** Professor Vladimiros Papangelakis
Chair, Undergraduate Assessment Committee

**Date:** November 8, 2024

**Re:** **Formalization of "Magic File" to Conditional Decision Regulation**

## REPORT CLASSIFICATION

This is a routine or minor policy matter that will be considered by the Executive Committee for approving and forwarding to Faculty Council to receive for information.

## BACKGROUND

"Magic file" refers to a decision for Special Considerations petitions when the request is a term withdrawal from a failed term. This decision is made when the committee is sympathetic to the circumstances outlined by the petition but is not fully convinced by:

1. the reasoning for sustained student underperformance; and/or
2. the evidence (documentation) to support the petition.

By this decision, the student is not granted the term withdrawal immediately and the official decision is "deny." However, the case is stored in a hypothetical "magic file," and the student is granted probation relief (if needed) to retake the term. The retroactive withdrawal is granted after a successful retake and completion of the affected term triggered by another student petition to re-activate the "magic file."

Concerns have been raised about this approach, by both students and Undergraduate Assessment Committee (UAC) members:

1. "Magic file" relies on the student re-petitioning after some time has passed and puts the onus on the student to judge their fitness for reevaluation. Thus, students that don't do so, are disadvantaged.
2. "Magic file" administration increases the adjudication time, it requires the UAC to reconsider the case, often when committee members who heard the original petition are no longer UAC members.

This process is not documented and is not transparent. The conditions for approving the repetition are not specified and can potentially lead to equity issues. The process is not within the UAC operating manual. Without a formal written decision, this process relies on the Academic Advisors to communicate the outcome and process to the student

**PROPOSED**

Going forward, the UAC will formalize the "Magic File" outcome:

- It will become an official decision, renamed a "conditional decision" and added as an outcome in the petition system;
- The conditions for granting the withdrawal will be articulated to the student in their petition decision;
- This outcome will remove the requirement for re-petition. If the student meets the conditions, the withdrawal will be processed by the Registrar's Office without another petition; and
- The process and the conditions for demonstrating mastery will be outlined in in the UAC operating manual. The committee interprets 60% term average as the minimum average to demonstrate mastery, to be consistent with faculty promotion regulations.

Conditions (default options):

1. Achieves a minimum average of 60% in each of 2 consecutive terms with full course loads and with no failed courses;
2. Achieves a minimum average of 60% in a single repeated term with a full course load and with no failed courses;
3. Other.

Default wording for "Conditional Decision":

> "The Committee acknowledges the situation described in your petition. At this time, no modification will be made to your academic record. If, however, you fulfil the requirements outlined in the decision details, this petition to withdraw will be granted. If necessary, the Committee will also grant temporary probation relief for you to continue to be enrolled. Details are outlined in the comments section."

**CONSULTATION PROCESS**

These changes have been reviewed and approved by the UAC, which is comprised of representatives from each undergraduate program, undergraduate students, the Vice-Dean, Undergraduate, the Vice-Dean, First Year, and the Registrar's Office.

**RECOMMENDATION FOR COUNCIL**

For information.