



UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

Meeting of Faculty Council

December 7, 2023 | 12:10-2:00 pm
 Hybrid (GB202 & Zoom)

AGENDA

- | | | |
|-----|------------------------------------------------------------------------------------------------------|----------------------|
| 1. | Speaker's Welcome and Approval of Agenda
<i>For approval as a regular motion</i> | N Yan |
| 2. | Introduction of New Faculty
<i>Jose Joaquin (JJ) Garcia-Luna-Aceves (ECE)</i> | D Kundur |
| 3. | Adoption of Minutes of Previous Meeting
<i>For approval as a regular motion</i> | N Yan |
| 4. | Memorial Tributes
<i>Cristiana Amza (ECE); James Keffer (MIE)</i> | D Kundur, M Bussmann |
| 5. | Report of the Dean | C Yip |
| 6. | Major Curriculum Changes, 2024-2025 (Report 3759R)
<i>For approval as a regular motion</i> | E Bentz |
| 7. | Information Reports
<i>To receive for information</i> | |
| | a. Engineering Graduate Education Committee Update
(Report 3756) | L Romkey |
| | b. Sessional Dates for Fall 2024-Winter 2029 (Report 3754R) | E Bentz |
| | c. Admissions Update (Report 3758) | S Haines |
| 8. | Other Business | N Yan |
| 9. | Date of Next Meeting | N Yan |
| 10. | Adjournment | N Yan |



**Council of the Faculty of Applied Science & Engineering
Minutes of the Meeting of October 31, 2023**

MEMBERS: Ning Yan (Interim Speaker), Chris Yip (Dean), Ravi Adve, Dionne Aleman, Cristina Amon, Julie Audet, Aereas Aung, Mohammed Basheer, Chris Beck, Shlomo Bibas, David Boroto, Helen Bright, Markus Bussmann, Liane Catalfo, Arthur Chan, Ron Chiong, Alan Chong, Will Cluett, Shai Cohen, Tom Coyle, Joe Dai, Michelle Deeton, Stark Draper, Matthew Du, Ryan Fang, Ege Feyzioglu, Diane Giang, Michael Guerzhoy, Sarah Haines, John Harrison, Marianne Hatzopoulou, Angela Henshilwood, Jenny Hill, Ken Hilton, Greg Jamieson, Fatemeh (May) Jazinizadeh, Parker Johnston, Shannon Jones, Dawn Kilkenny, Daeho Kim, Don Kirk, Deepa Kundur, Katy Kwong, George Liu, Xilin Liu, Allison MacKay, Gaurika Mahajan, Sam Mantenuto, Mark Rittinger, Elham Marzi, Kasra Modares, Emily Moore, Erika Narimatsu, Milos Popovic, Adham Ragab, Asim Rahman, Aryan Rezaei Rad, Jonathan Rocheleau, Lisa Romkey, Jonathan Rose, Cindy Rottmann, Miko Samson, Philipp Seiler, Agnes So, Theodore Soong, Marisa Sterling, Micah Stickel, Deborah Tihanyi, Hamid Timorabadi, John Walker, Elizabeth Whitmell, Kaitlyn Wong, Kennice Wong, Natalie Wong, Yu Zou

SECRETARIAT: Caroline Ziegler (Secretary), Alex Schroen (Moderator)

GUESTS: Chris Brown, Sharon Brown, Emma Davidson, Leanne Dawkins, Khuong Doan, Pierina Filippone, Roger Francis, Shilpa Gantotti, Rodney Gensell, Leslie Grife, Krysta Halliwell, Christina Heidorn, Oje Izirein, Julie Kang, Minsoo Koh, Sherry Lin, Andrea Luna Yong, Teresa Miniaci, Don Newton, Dan Pettigrew, Zeeshan Rayees, Ingrid Schvarczkopf, Frank Scornaienchi, Peter Serles, Saheb Tabassum, Tristan Tapscott, Alex Tichine, Nefeteria Wickham

1. Speaker's Welcome

Interim Council Speaker Ning Yan called the first Faculty Council meeting of 2023-2024 to order at 12:10 pm, welcoming new Council members in GB202 and online. She explained that she will be the Speaker while Jun Nogami is on leave this academic year.

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.

2. Approval of Agenda

The agenda and reports were distributed on October 20 and updates to the memorial tribute and standing committee appointments were distributed on October 26.

There was no discussion and on a regular motion duly moved, seconded and carried, the agenda was approved.

3. Introduction of New Faculty Members

New faculty members Aereas Aung and Caitlin Maikawa of Biomedical Engineering; Mohammed Basheer of Civil & Mineral Engineering; Xilin Liu of Electrical & Computer Engineering; and Fatemeh (May) Jazinizadeh of Mechanical & Industrial Engineering were introduced by their respective chairs and directors.

4. Adoption of the Minutes of Previous Meetings

No errors or omissions were noted in the minutes of the April 26, 2023 Council meeting and on a regular motion duly moved, seconded and carried, the minutes were approved.

5. Memorial Tribute

Deepa Kundur, chair of Electrical & Computer Engineering, read the following memorial tribute in honour of University Professor Emeritus Walter Murray Wonham.

Be it resolved –

THAT the Council of the Faculty of Applied Science & Engineering record with deep regret the death on May 14, 2023 of University Professor Emeritus Walter Murray Wonham.

Professor Walter Murray Wonham was a giant in the field of control systems and garnered international attention for his work. In addition, he was polylingual; a bibliophile; a sailor, skier and tennis player; and he held a great love for traditional Chinese literature and poetry.

Murray was born in 1934. He married Anne Wonham (née Hale) and has two daughters, Cynthia and Marjorie. After graduating high school in Montreal, Murray studied Engineering Physics at McGill University, earning his degree in 1956. He followed that with a PhD in Control Engineering from the University of Cambridge in 1961.

Beginning in the 1960s, he worked with several institutions, including those at Purdue University and Brown University, as well as NASA. During this time, he furthered his research on stochastic filtering and control, developing the ‘Wonham filter’ — cited today by researchers in quantum systems — along with new results on Matrix Riccati equations and the separation theorem of stochastic control, now found in textbooks around the world. Murray’s research then changed focus, turning to linear multivariable control, and in 1967 he was the first to prove the famous pole assignment theorem, which has become a staple of undergraduate courses on state space control, including courses in the ECE department.

By 1970, Murray had moved back to Canada, taking a position in U of T as a faculty member in the Systems Control Group in the then-named Department of Electrical Engineering. Early in his U of T career, he pioneered the geometric approach to linear time-invariant (LTI) systems and developed the internal model principle. His success produced a new level of understanding along with valuable tools, but it also opened up new problems, inspiring a generation of control theorists to try and replicate in the nonlinear domain what Murray had achieved in the linear.

It was clear with each of Murray's research publications that he was a deep thinker and visionary. This culminated in 1979 with "arguably one of the best books ever written in control theory," says ECE Professor Manfredi Maggiore, referring to *Linear Multivariable Control: A Geometric Approach*, which was subsequently issued in three editions and translated into Russian and Chinese. The running joke, originated by Murray's former student and collaborator Professor Emeritus Bruce Francis, is that you could teach an entire graduate course out of the book's Chapter 0: 'Mathematical Preliminaries.'

In the spring of 1979, Murray taught Peter Ramadge, now a professor at Princeton University, who remembers the elegant simplicity Murray wielded to resolve fundamental concepts and important questions: "It was something that deeply resonated with me," says Ramadge. He also recalls Murray enjoying the occasional lunch with students at a local Chinese restaurant. Many came away from these lunches with a better understanding of what makes good research and how to think about research problems.

In the 1980s, Murray initiated the field of supervisory control of discrete-event systems along with Ramadge (who had become his doctoral student). Professor Shahin Hashtrudi Zad of Concordia University, looking back on the years as Murray's student, notes his signature insightfulness, how he could find connections other researchers overlooked: "Professor Wonham's work showed that the two theories, geometric control and supervisory control, share a lot of similarities, especially from an algebraic point of view."

Murray's thinking in this area was eventually outlined in books, the first published in 2005 with Chuan Ma, a second in 2015 with Kai Cai. For many years Murray's graduate course notes on this topic were made available for free online and have greatly influenced generations of researchers. Eventually, in 2019, they became his final book, co-authored again with Kai Cai, entitled *Supervisory Control of Discrete-Event Systems*.

During his time at U of T, Murray held visiting lectureships across the globe, including academic institutions and universities in the United States, China, Germany, India and Mexico. Combining his research work with his love of travel gave him great pleasure, and he would regale everyone on his return of his adventures with host students. In 1996 Murray was appointed University Professor, and he retired in 2000 as University Professor Emeritus at U of T.

Throughout his life, Murray received a plethora of awards and recognitions. He was made a Fellow of the Royal Society of Canada and a Life Fellow of the Institute of Electrical and Electronics Engineers (IEEE). He was a Foreign Member of the U.S. National Academy of Engineering and an Honorary Professor of Beihang University, then-known as the Beijing

University of Aeronautics and Astronautics. In 1987 he received the IEEE Control Systems Science and Engineering Award and in 1990 he was the Brouwer Medallist of the Netherlands Mathematical Society. After retirement, he remained an active and engaged researcher and supervisor of graduate students. In 2020 he was awarded the Giorgio Quazza Medallist of the International Federation of Automatic Control.

Murray was a true gentleman whose pursuit of truth was an aesthetic one, a principle he embraced in all facets of his life. His door was always open with a note that read simply “knock and enter,” and his brilliance and his teaching shaped many students into leaders in their fields. Jonathan Ostroff of York University says, “He demanded my best academic work but also had a gracious understanding of my personal life,” a sentiment echoed by Murray’s colleague and Professor Emeritus Raymond Kwong: “I have lost not only an outstanding colleague but also a personal friend.” Murray will be deeply missed by all those who knew him.

Be it further resolved –

THAT this tribute to University Professor Emeritus Walter Murray Wonham 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 Professor Wonham.

6. Report of the Dean

Dean Chris Yip welcomed all to Council and acknowledged new chairs and directors, namely Natalie Enright Jerger of Engineering Science, Marianne Hatzopoulou of Civil & Mineral Engineering, Milos Popovic of Biomedical Engineering, and Greg Jamieson of the Institute for Studies in Transdisciplinary Engineering Education & Practice (acting). He thanked members for a phenomenal start to the academic year, in particular the Engineering Society (EngSoc), and provided the following remarks.

(a) Recruitment and Admissions

This year we welcomed just under 1,400 first year students to our programs, 38% of whom are women. Enrolment has been increasing for international students as well, drawing now from India, Japan, Malaysia and Indonesia.

(b) External Reviews

The FASE provostial review visit will occur on December 4-6, 2023. The draft Engineering self-study is posted online and has been sent to the Provost’s Office for feedback. The external review team includes Nora de Leeuw, Executive Dean, Faculty of Engineering and Physical Sciences, University of Leeds; Jim A. Nicell, former Dean, Faculty of Engineering, McGill University; and Ishwar Puri, Senior Vice-President of Research and Innovation, University of Southern California and former Dean of McMaster Engineering.

Engineering Science's external review visit was completed on October 16-17. We have received the review report and will forward it to the Vice-Provost, Academic Programs who will request our administrative response to recommendations in the report. The external review visit of the Department of Civil & Mineral Engineering will be on November 2-3. The Mechanical & Industrial Engineering administrative response regarding their June 2022 visit was well received by the Committee on Academic Policy & Programs last week. Their review has concluded. External reviews of the Cross-Disciplinary Programs Office and minors and certificates, Materials Science & Engineering, and Aerospace Studies are scheduled for the winter term.

These reviews are important to the University and province for quality assurance and are extremely valuable to the units and Faculty as a critical reflection on our progress and a focus for future plans. Thank you to those participating in the reviews and those who helped prepare.

(c) Academic Plan

As many are aware, our academic planning cycle has been extended for a year. The Vice-Dean, Strategic is managing this process and her office will begin consultations in the upcoming months.

(d) Graduation Breakfast and Convocation

Convocations for the Bachelor of Applied Science, Bachelor of Applied Science in Engineering Science, Master of Engineering, Master of Engineering in Cities Engineering and Management, Master of Engineering in Design and Manufacturing, Master of Health Science (Clinical Engineering), Master of Applied Science, and Doctor of Philosophy will be on November 9 from 10:00-11:30 am in Convocation Hall. A graduation breakfast, hosted by Advancement, will be held from 7:30-9:30 am in the Bahen Atrium.

(e) The Pit Survey

The Provost's office, Dean's office and the Engineering Society have formed a partnership to renovate "the Pit" in the Sandford Fleming basement. A survey asking participants to vote on two renderings of the space – to fill it in or to retain it – closed yesterday. Over 500 responses were received. Accessibility and cleanliness are key.

(f) Annual Report

Two recent publications, *U of T Engineering Impact Report 2023: Celebrating 150 Years of Impact*, and *By the Numbers 2023*, are available on the Faculty's website. These describe the Faculty's progress and achievements in graduate studies, undergraduate studies and research. An impact deck of approximately 100 slides has also been created that summarizes the *Impact Report*. This is available for use for external presentations. Thank you to Strategic Communications for pulling these items together.

(g) Advancement Updates

The 150th Anniversary open house here on campus was a success, with approximately 700 in attendance. The day included amazing lectures, student demonstrations, and a tour of some of the engineering spaces. Thank you to everyone involved in the planning and implementation of

the event, and thanks to all who participated. We anticipate a very busy fall with continued enthusiasm around the 150th Anniversary.

(h) Travel Update

Recent travel includes a trip to California to meet with alumni in the region. A trip to Hong Kong is planned for November, where a celebration of the Faculty's 150th Anniversary will be held for alumni there.

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

7. Information Reports

(a) Engineering Graduate Education Committee Update

Lisa Romkey, chair of the Engineering Graduate Education Committee, presented Report 3751, which describes approval of CHE3010 and CHE3012, a modification to MSE1040, and a name change involving CHE1135.

There was no discussion, and the report was received for information.

(b) Expanded Definitions for Type C Exams

Arthur Chan, chair of the Undergraduate Assessment Committee, presented Report 3748, regarding expanded definitions of "Type C" exams. This exam type was introduced in Report 3588 and approved by Council in April 2018 to represent a standard and structured way for instructors to indicate examinations in which an aid sheet is permitted. There has since been ambiguity around what a "handwritten" aid sheet means which has resulted in confusion and inconsistent implementation and has in some cases led to inequitable application. The Undergraduate Assessment Committee proposes to update the definition of Type C exams by creating three subtypes that will provide additional clarity.

During discussions, Professor Chan confirmed that this change will be implemented for the fall of 2023.

The report was received for information.

(c) Further Clarification of Policy regarding Return of Graded Work Prior to Drop Deadline

Arthur Chan, chair of the Undergraduate Assessment Committee, presented Report 3749. In February 2023, Council approved Report 3739, changes to academic regulation Section XI, subsection 4a to clarify that one or more pieces of session work cumulatively worth at least 10% of the final course grade shall be returned to the class prior to the last day for withdrawal from the course without academic penalty. Since then, students have raised concerns that enabling multiple smaller assignments to meet the 10% requirement may not provide a sufficient indication of their performance. The Undergraduate Assessment Committee agrees

that “closely supervised work” would provide a better indication of student performance and proposes to update the policy accordingly.

During discussions, Professor Chan confirmed that this policy will come into effect in Winter 2024. A member stated that the 10% return by the drop date is University policy, and that the Faculty is strengthening this rule.

The report was received for information.

(d) Report of the Academic Appeals Board (Undergraduate), September 2022-September 2023

Don Kirk, chair of the Academic Appeals Board (Undergraduate), presented Report 3753, a summary of appeals and dispositions for the 2022-2023 academic year, and commented on updates, trends, and observations within academic appeals.

He stated that the number of appeals has been rising and cases are increasingly complex with a larger volume of material. These cases are taking longer, and it is difficult for Board members to have the availability to meet with students. An increasing number of students are requesting deferred exams, but these are exceptional circumstances in our Faculty and very few are granted for various reasons.

Appeals are held *in camera*, but students may be reticent to discuss personal matters. The Board tries to ensure that all its members are culturally aware and that the appellant is made comfortable when discussing their scenario.

Professor Kirk thanked faculty and student members of the Board, as well as the recording secretary, whose support was exceptional.

The report was received for information.

8. Standing Committee and Academic Appeals Board (Undergraduate) Appointments, 2023-2024

The Speaker presented Report 3752 Revised, 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.

9. Report of the Engineering Alumni Network Awards Committee, 2022-2023

Liane Catalfo, president of the Engineering Alumni Network, (EAN) presented Report 3750, recommendations for the 2022-2023 Engineering Alumni Medal, Malcolm McGrath Alumni Achievement Award, 2T5 Mid-Career Award, 7T6 Early-Career Award, and L.E. (Ted) Jones Award, as well as inductees in the Engineering Hall of Distinction. The annual EAN Awards Ceremony will be held on November 2 in the Great Hall at Hart House.

10. Other Business

There was no other business.

11. Accessibility Services and Accommodated Testing Services regarding Student Support

Emma Davidson of the University's Accommodated Testing Services (ATS) and Krysta Halliwell of U of T Accessibility Services presented on student support.

ATS coordinates accommodations for all timed assessments for students who are registered with Accessibility Services on the St. George Campus. It works in partnership with all Faculties, programs, and course delivery options to support the community in meeting students' accommodation needs, specifically the coordination of test/exam accommodations for students with approved accommodations. Testing accommodation can include extra writing time, adaptive furniture, alternate exam formats, adaptive software, stopped-clock breaks and assistive staff.

Accessibility Services collaborates with faculty, staff and registered students to provide individualized accommodations that meet the needs of students while ensuring the academic integrity of the University. This includes intake, documentation review, accommodations plan development and approval, service referral and continuous management of students' accommodations.

It was stated during discussions that instructors sometimes leave out certain aids, such as rulers, aid sheets and calculators, when submitting test/exam details to ATS. This can make exams an even more stressful experience for students. To help prevent this, there is a prompt in the system that asks instructors if there are any allowed aids, giving examples and options to check off. This is useful in case there is conflicting information from students and instructors about what is allowed to be in the exam room. If instructors encounter a problem with an exam during business hours, they can call or email the invigilator office to reach staff who work directly with students.

The presenters are at Council to raise awareness of their services and to emphasize how seemingly small issues can impact students. They can collaborate with Faculties to improve their systems and avoid miscommunications that may arise during the process. They have also developed online Faculty Guidelines on Accommodations which deal with the most common issues like extensions. Council members are encouraged to contact ATS and Accessibility Services to discuss their needs or what might work for their Faculty.

12. Date of Next Meeting

The next Faculty Council meeting is on December 7, 2023.

13. Adjournment

The meeting was adjourned at 1:42 pm.

/cz
11/21/2023 1:16 PM



UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

Memorial Tribute to

CRISTIANA AMZA

Professor

The Edward S. Rogers Sr. Department of Electrical & Computer Engineering

December 7, 2023

Be it resolved –

THAT the Council of the Faculty of Applied Science & Engineering record with deep regret the death on September 8, 2023 of Professor Cristiana Amza.

Professor Cristiana Amza was born in Bucharest, Romania, in 1968. With her husband Marius, she has two children, Stefan and Gabriela.

Cristiana was driven from an early age by her love for computer science. She graduated from Bucharest Polytechnic University in 1991 and followed her passion across the Atlantic to Rice University in Houston, U.S., where she completed her master's degree in 1997 and her PhD in 2003. She achieved her goal of becoming a professor that same year in The Edward S. Rogers Sr. Department of Electrical & Computer Engineering (ECE) at the University of Toronto, eventually promoted to Full Professor by 2018.

Cristiana's research in distributed systems and cloud computing was internationally acclaimed and widely cited. Her research project called "Treadmarks," published in 1996 is an excellent example of how a simple, clean interface based on well-defined abstractions can provide a powerful and potentially useful parallel system. She was able to implement a "lazy" release consistency model for shared memory on a network of workstations that are not connected by physical memory. Treadmarks made a range of applications more efficient, and it was a natural environment for writing programs. Cristiana also made significant contributions to enhance the efficiency and reliability of cloud-based infrastructure, developing new techniques to optimize resource allocation of computers and networks that maximized performance and minimized costs. She worked towards a cloud infrastructure that could self-manage, self-tune and self-heal for a scalable, diverse range of applications, such as e-commerce, online bidding, neuroscience modelling and multiplayer games.

Over the years, Cristiana received numerous awards and recognitions, including IBM's 2011 CASCON International conference best paper award, the 2008 Middleware Conference best paper award and the 2007 Early Research Award. She collaborated with some of the most influential companies in the industry, including Intel, Bell Canada and IBM.

Cristiana had a special rapport with her students, who thought very highly of her. She was sharp-minded and generous, and during her time in ECE she guided and mentored many to great accomplishments. Professor Khoman Phang observed that her feedback with undergraduates was so gentle, encouraging and positive, it allowed them to relax and absorb what she had to say. Professor Ashvin Goel, who followed her as an instructor of a computer programming course, says, "Her exams in the course were legendary. They helped me understand the course material better!" Professor Mark Jeffrey credits her with a significant impact on his career: "She was one of the first to pique my interest in computer performance," he says. "Her quiet chuckle at her own jokes was legendary among my peers. We loved it."

This picture of a kind and selfless person, a genuine friend to many in the department, is repeated again and again by those who knew her. Over the years, conversations extended beyond engineering into the day-to-day joys and struggles of a life in academia, of finding a balance between work and family, always punctuated with Cristiana's trademark smile. Professor Ding Yuan first met Cristiana when he was a graduate student and she was on his hiring committee the year he was hired. "When I first came to U of T, Cristiana was a mentor and she and her family also helped us in every possible way in our move to Toronto. She was one of the most selfless and kind people I've known."

Professor and Chair, Deepa Kundur reflects on Cristiana's legacy: "She was a kind, sensitive and gentle soul and a genuine friend to many colleagues in the department. She was incredibly talented, thoughtful and didn't hesitate to stand up for the underdog."

Cristiana's tenacity, her intellectual curiosity, and her friendliness and warmth made her such a beloved colleague. She will be sorely missed.

Be it further resolved –

THAT this tribute to Professor Cristiana Amza 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.

Prepared by Professor and Chair Deepa Kundur; Professors Emeriti Phil Anderson and Safwat Zaky; and Professors Ravi Adve, Berj Bardakjian, Vaughn Betz, Margaret Cheng, George Eleftheriades, Ashvin Goel, Mark Jeffrey, Ashish Khisti, Baochun Li, David Lie, Antonio Liscidini, Hoi-Kwong Lo, Mo Mojahedi, Wai Tung Ng, Khoman Phang, Li Qian, Micah Stickel, Shahrokh Valaee, Andreas Veneris, Belinda Wang, Paul Yoo, and Ding Yuan



UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

Memorial Tribute to

JAMES (JIM) FENNEL KEFFER

Professor Emeritus
Department of Mechanical & Industrial Engineering

December 7, 2023

Be it resolved –

THAT the Council of the Faculty of Applied Science & Engineering record with deep regret the death on September 29, 2023 of Professor Emeritus James (Jim) Fennell Keffer.

A distinguished professor, researcher, teacher and administrator at the University of Toronto, Professor Emeritus Jim Keffer made lasting contributions to fluid mechanics, and heightened the international research profile of U of T during a remarkable career.

Born in 1933, Jim pursued his undergraduate mechanical engineering studies at U of T. Maintaining an honours standing while playing football for the Varsity Blues, Jim was a member of the U of T Hall of Fame team that won the Yates Cup in 1954. After graduating in 1956, Jim joined the research division of Canadian General Electric, which led to his return to U of T for graduate studies. Advised by Professor Doug Baines, Jim obtained his PhD in mechanical engineering in 1962 and then spent two years as a postdoctoral fellow at the Cavendish Laboratory at Cambridge. On his return to Canada, he joined U of T's Department of Mechanical Engineering as an Assistant Professor.

Jim's lifetime of research advanced understanding of fluid mechanics with emphasis on two fundamental shear flows: the wake and the jet. He used novel experimental techniques to investigate these basic flows, which are relevant to environmental problems such as pollutant dispersion, smokestack dispersion, and climate effects. Jim and his students developed rigorous theoretical analyses to support their experimental data and to evaluate their validity and limitations, an important contribution to computer models.

Jim had a keen ability to recognize and plan for the future. Through his efforts, he helped the department and university acquire a unique wind tunnel in the 1970s that remains in use to this day. This facility allowed him to perform sophisticated measurements for the first time and contributed to his widely cited and highly respected work. The quality and significance of his research brought many interested students to his lab. Those under his supervision graduated to

become university professors and global industry leaders who continue to contribute to turbulence measurement and analysis.

Jim's roles at U of T extended far beyond the classroom and his lab, as he undertook several administrative positions. He served as the Director of Graduate Studies for Mechanical Engineering, which led to appointments as the Associate Dean at the School of Graduate Studies, and later as Vice-Provost, Professional Faculties. Before retirement, Jim's final appointment was as Vice-President, Research and International Relations. In this role, he firmly established a professional service orientation within the portfolio; made major organizational innovations that his successors have built on to increase U of T's international research profile; and brought the first Cray supercomputer to the campus.

Jim formally retired from U of T in 1999. He and his late wife, Anne, enjoyed their retirement. Summers were spent cruising on their yacht in Georgian Bay; winters were spent in Florida. After Anne passed away in 2015, Jim married Carol Moore-Ede, a family acquaintance of some years. Jim often remarked that he was indeed fortunate to be so lucky twice in one lifetime.

Be it further resolved –

THAT this tribute to Professor Emeritus James (Jim) Fennell Keffer 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.

Prepared with input from Pierre Sullivan, Judith Chadwick and Carol Moore-Ede



UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

Report No. 3759 Revised

MEMORANDUM

To: Executive Committee of Faculty Council (November 14, 2023)
 Faculty Council (December 7, 2023)

From: Professor Evan Bentz
 Chair, Undergraduate Curriculum Committee

Date: November 7, 2023; revised November 14, 2023

Re: Major Curriculum Changes for the 2024-2025 Academic Year

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

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

PROPOSED

This report summarizes course changes proposed for the 2024-2025 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 2024-2025 academic year, as described in Report 3759 Revised, be approved.

PROPOSED CURRICULUM CHANGES

1. CHEMICAL ENGINEERING & APPLIED CHEMISTRY

1.1. Update course description for **CHE113: Concepts in Chemical Engineering**

CURRENT course description: This course provides first year students with an overview of the chemical industry, the chemical engineering profession, and introduces key concepts for the upcoming years of study. The chemical industry is the interface between natural resources (minerals, oil, gas, agricultural products, etc.) and the consumers of the higher value products derived therefrom. This diverse industry has both high volume-low unit value and low volume-high unit value products, and the manufacture of each type of product has its own challenges. The chemical engineering profession applies the scientific fundamentals through two key concepts: Unit Operations as well as Flux. The fundamental elements of stoichiometry and reaction kinetics are further extended to cover the concepts of yield, conversion and their specific applications to continuous and batch reactor systems. Analysis of electrical circuits is introduced, leading to nodal analysis of circuits. The application of resistance in series and capacitance is extended into chemical engineering problems involved, heat transfer, mass transfer and momentum transfer, as well as reaction engineering. The laboratory will reinforce these key chemical engineering principles.

PROPOSED course description: This course provides first year students with an introduction of the key concepts that underpin the chemical engineering discipline and their application to address global challenges. The course will introduce the chemical industry as the interface between natural resources (minerals, water, air, oil, agricultural products, etc.) and the wide range of higher value products (materials, energy, clean water, food, pharmaceuticals, etc.) utilized in our society and the challenges and opportunities for the industry as part of a sustainable future. The course will introduce four core concepts underpinning the discipline of chemical engineering: thermodynamics (driving force); transport phenomena (heat, mass, momentum); reaction kinetics (rates); and unit operations. Topics covered include: the control volume approach; material and energy balances; flux; and reaction yield and conversion, with applications to batch and continuous systems. The course will introduce the connections between these foundational concepts and how they relate to our understanding of chemical and biochemical systems at various scales. The laboratory will reinforce these key chemical engineering principles.

- *Course is being revised to focus on the four core concepts underpinning the discipline of chemical engineering and introduce the connections between these foundational concepts and how they relate to our understanding of chemical and biochemical systems at various scales. Content related to electric circuits is being removed.*

1.2. Update course description for **CHE223: Statistics**

CURRENT course description: Analysis of data using statistics and design of experiments. Topics include probability, properties of the normal distribution, confidence intervals, hypothesis testing, fitting equations to data, analysis of variance and design of experiments. The tutorial involves, in part, the application of commercial software to interpret experimental data, as obtained in Chemical Engineering laboratories.

PROPOSED course description: This course provides students with an introduction to statistical learning, namely the building of models from data. The course begins with foundational topics in elementary statistics. In the statistical learning portion of the course, the problem is formulated in terms of a system having input and output variables, the main goals of prediction and inference are presented, mean square error is defined, and the bias-variance trade-off is described in the context of overfitting the data. Statistical learning methodologies that are covered include K-Nearest Neighbours (KNN) regression, simple linear regression, multiple linear regression, and principal component analysis. Cross-validation is introduced as a popular method for model assessment and selection. The tutorial involves extensive computer-based simulation work to help students understand and appreciate the key concepts and to gain experience applying statistical learning to real data.

- *Course is being revised to give students an introduction to statistical learning.*

1.3. Update course description for **CHE311: Separation Processes**

CURRENT course description: Staged equilibrium and rate governed separation processes for gases and liquids. Topics include equilibrium stage calculations, cascade separation, binary distillation, gas absorption and stripping, liquid-liquid extraction, membrane processes, adsorption and ion exchange. Experiments in fluid mechanics, heat transfer and related unit operations.

PROPOSED course description: This course introduces students to fluid separations processes used in a variety of industries, such as (petro)chemical, (bio)pharmaceutical, carbon capture, water treatment and desalination, and mining and metals. The course will describe fundamentals of unit operations that comprise these separation processes. Staged-equilibrium processes such as distillation, absorption, and extraction will be discussed. Other unit operations that will be covered include membrane separations, adsorption, chromatography, ion exchange, crystallization, sedimentation, and centrifugation. Energy efficiency and minimum energy of separations will be discussed. Process modeling software will be introduced.

- *Course is being revised to focus more on modern separation processes.*

1.4. Update course description for **CHE322: Process Control**

CURRENT course description: The major goal of this course is to teach students how to design control strategies for chemical processes. The first part of the course focuses on the types of interconnections encountered in chemical engineering, namely feedback, parallel and series connections, and their effect on the process dynamics. The second part of the course looks at the design of feedback, feedforward, cascade and multivariable control strategies for these processes and interprets these types of engineered interconnections in terms of the effect they have on the performance of the overall system. This course makes extensive use of active learning through computer simulation based on MATLAB/Simulink and Aspen Plus Dynamics software.

PROPOSED course description: The major goal of this course is to teach students how to design control strategies for chemical processes. The first part of the course focuses on the process dynamics of different types of interconnections encountered in chemical engineering, namely feedback, parallel and series connections. The second part of the course focuses on the design of control strategies for these processes, with an emphasis on feedback controllers. Students will learn to interpret these engineered interconnections and controllers in terms of their impact on the overall system's performance and safety. Computer simulation of dynamic processes and controllers is extensively used in the course.

- *Mention of specific simulation software is being removed.*

2. **CIVIL & MINERAL ENGINEERING**

2.1. Redesign content of **CME321: Geotechnical Engineering I** & **CIV324: Geotechnical Engineering II**

CME321: Geotechnical Engineering I

AU– 75% Eng. Science/ 25% Eng. Design

GA– 1 – Knowledge Base: C

PROPOSED course description: Introduction to soil as an engineering material, its behaviour (stress-strain) and how behaviour is measured, and a brief introduction to geotechnical design. Topics include introduction and fundamentals such as soil types, and phase relations, principle of effective stress, groundwater flow and permeability, consolidation of clay, magnitude of settlement resulting from primary consolidation, consolidation history and compressibility parameters, behaviour of soil in shear, common laboratory tests, drained versus undrained shear, shear strength, peak vs residual friction angle, critical state soil mechanics, geotechnical field characterization, drilling and sampling methods, SPT and CPT, slope stability, analysis and design of a tailings dam. Laboratories are an essential part of this course and a number of labs will be scheduled for students.

CIV324: Geotechnical Engineering II

AU– 50% Eng. Science/ 50% Eng. Design

GA– 1 – Knowledge Base – C / 2 – Problem Analysis

PROPOSED course description: The second geotechnical engineering course expands the theoretical background developed in CME321 by introducing more practical topics and extending the theory to a few common examples of design. It discusses some applications of soil mechanics, introduces common geotechnical structures, classification of soils, compaction, engineering of water in ground, Internal erosion and filter criteria, stresses in soil, shear strength of soil, design of retaining structures, settlements, and design of shallow footings. Laboratories are an essential part of this course and a number of labs will be scheduled for students.

- *These two courses were taught in an unusual way previously and the goal is to move them back to a conventional course sequence.*

2.2. Add prerequisite of **CME270H1F – Fluid Mechanics, CIV250H1S: Hydraulics and Hydrology** for **CIV340H1S: Municipal Engineering**

2.3. Change the timing of classes for **CIV235H1F: Graphics**

CURRENT timing: 6 hours (2 hours of PRA, three times a week)

PROPOSED timing: 6 hours (2 hours LEC + 2 hours of PRA twice a week)

1. LEC: 2 hours per week for the entire class in one classroom.
2. PRA part 1 (Freehand drawing): 4 hours per week (2 x 2) for the entire class in one classroom.
3. PRA parts 2 and 3 (which require computers), we will divide the class into two sections due to the limited capacity of our computer lab. Each section will have 4 hours per week.

2.4. Add new technical elective: **CIV5XXH1S**

PROPOSED lecture timing: 3/0/2

PROPOSED course description: Specialized course in the design of timber structures. Topics include physical and mechanical behavioral analysis of wood and wood-based products, description of structural wood-based systems, limit state design concept in timber engineering, design and detailing of timber connections, elements, and components, computer-aided design approach for timber structures, digital fabrication concepts, and design of heavy timber structures.

- *This course has been taught as a 1000 level course for one year and the instructor wants to have it available for undergrads as well.*

3. ELECTRICAL AND COMPUTER ENGINEERING

3.1. Update course title and description for **MAT291: Calculus 3**

CURRENT course title and description: **MAT291: Calculus 3** - The chain rule for functions of several variables; the gradient. Multiple integrals; change of variables, Jacobians, line integrals, the divergence and curl of a vector field. Surface integrals; parametric and explicit representations, Divergence theorem and Stokes' theorem and applications from electromagnetic fields and Green's theorem.

PROPOSED course title and description: **MAT291: Introduction to Mathematical Physics** - The chain rule for functions of several variables; the gradient, directional derivative, tangent plane and small signal modeling and Jacobians. Multiple integrals; change of variables and Jacobians, line integrals: parametric and explicit representations. Surface integrals; parametric and explicit representations, multi-variable Dirac Delta distribution, superposition of vector fields, Helmholtz decomposition theorem, Divergence theorem and Stokes' theorem and applications from electromagnetic fields.

- *The course title does not adequately reflect the course content and the content has changed slightly.*

3.2. Update **ECE231: Introductory Electronics** course description.

CURRENT course description: Provides methods for the analysis and design of electrical circuits based on semiconductor nonlinear components (diodes, bipolar junction transistors and field effect transistors) and operational amplifiers. The course discusses basic physical operation of semiconductor devices, current-voltage characteristics, operating regions, DC modeling, small-signal modelling and biasing. Fundamental circuits are covered, such as rectifiers, limiting and clamping circuits and transistors amplifiers. Finally, operational amplifier non-idealities are addressed, including the impact on circuit applications.

PROPOSED course description: Provides methods for the analysis and design of electrical circuits based on semiconductor nonlinear components (diodes, bipolar junction transistors and field effect transistors) and operational amplifiers. The course discusses basic physical operation of semiconductor devices, current-voltage characteristics, operating regions, DC modeling, small-signal modelling and biasing. Fundamental circuits are covered, such as rectifiers, limiting and clamping circuits and transistors amplifiers. Finally, the operational amplifier ** is introduced and ** its non-idealities addressed, including the impact on circuit applications.

3.3. Change **ECE231: Introductory Electronics** course offering from Winter to Fall term.

- *ECE231 is needed in the fall semester. That ECE231 should be a pre-requisite for ECE295 is clear. More broadly, however, the move addresses the current imbalance of EE and CE students. The introduction of ECE295 in 2021-2022 has already had a significant impact in opening students minds toward electronics, communications, and hardware design. However, both ECE295 and ECE231 come*

too late as the ECE flexible curriculum requires students to select their kernel areas in the preceding fall semester of second year.

- *Through both the course material and its labs, ECE231 applies many areas of EE (electrical engineering), including semiconductor devices, signal processing, motors and actuators, and photonics. Moving ECE231 to the fall would expose students to these more 'EE' areas early enough to have an impact on their choice of kernel areas and their subsequent course choices in third and fourth year.*

3.4. Change **ECE212: Circuit Analysis** course offering from Fall to Winter term.

- *This is part two of the proposed plan to swap ECE231 and ECE212 in second year, and which has been presented on the system as two complementary course change requests.*
- *The effect of delaying ECE212 is manageable, and should not adversely affect the students or ECE curriculum. In fact, delaying ECE212 has the positive effect of freeing the course from being tied too closely to ECE110. Historically, ECE212 was the first circuits course and so necessarily preceded ECE231. However, that is no longer the case with the existence of ECE110 in first year; about half of ECE110 is basic circuit analysis, sufficient for students to proceed with ECE231.*
- *Delaying ECE212 gives students an additional course and semester to apply and hone their basic circuit analysis skills within ECE231. As such, less time will be necessary for the review of basic circuit analysis, and ECE212 will become more streamlined to focus on the analysis of circuits (and systems) in the frequency domain. Having ECE212 concurrent with ECE216 Signals and Systems also opens up opportunities to reinforce concepts that are common to the two courses (e.g. system concepts in ECE216 such as transfer functions can be tied to active filter design in ECE212 employing operational amplifiers).*

4. **ENGINEERING SCIENCE**

4.1. Change delivery and course description for **ESC204H1S: Praxis III**

CURRENT delivery: 1-5-1 (Lecture/Practical/Tutorials)

PROPOSED delivery: 3-2-2 (Lecture/Practical/Tutorials)

CURRENT course description: Praxis III is the capstone course of the Engineering Science Foundation Design sequence and challenges students to apply the models of engineering design, communication, teamwork, and professionalism introduced and developed in Praxis I and II to the design and testing of a functioning product prototype. The course requires students to integrate the design, technical, and complementary knowledge gained across the Engineering Science Foundation in the context of a single, major, full-term design project.

Teams in Praxis III choose from a curated set of opportunities that integrate technical and complementary considerations. They are responsible both for framing the opportunity and for designing and testing a product prototype that addresses the opportunity. Praxis III culminates in a public showcase where teams present and demonstrate their designs to their stakeholders and to the general public. All courses within the Foundation Design sequence use engineering design to provide a context in which students integrate their knowledge, develop their emerging engineering identity, and codify their individual approach to engineering practice.

PROPOSED course description: Praxis III is the capstone course of the Engineering Science Foundation Design sequence. It challenges students to extend and apply the models of engineering design, communication, teamwork, and professionalism introduced and developed in Praxis I and II to engineering design in a complex collaboration setting. Students integrate the design, technical, and complementary knowledge gained across the Engineering Science Foundation curriculum in the context of a single, major, mechatronic design project.

Teams in Praxis III choose from a curated set of opportunity areas that integrate technical, complementary, and optionally, multidisciplinary, considerations. They are responsible both for framing a specific opportunity within their chosen area and for developing a valid design idea for the opportunity supported by a mechatronic prototype. Praxis III culminates in a public showcase where teams present their design process and outcomes to an external audience. All courses within the Foundation Design sequence use engineering design to provide a context in which students integrate their knowledge, develop their emerging engineering identity, and codify their individual approach to engineering practice.

- *To agree with current delivery format.*

4.2. Change AU distribution for **ECE253H1F: Digital and Computer Systems**

CURRENT AU distribution: 30% Engineering Design/70% Engineering Science

PROPOSED AU distribution: 40% Engineering Design/60% Engineering Science

- *ECE253 covers digital and computer systems. The course has a weekly 3-hour practical session. Over the course of the semester, students complete 9 practical assessments. Each assessment involves components of engineering design, such as open-ended design problems, consideration of alternative solutions and decision-making, implementation processes, testing, teamwork, and communication. As the semester progresses, the practical assessments increase in design complexity. Practical assessment constitutes 25% of each student's final grade in the course. In addition, design is also assessed on the midterm and final. Approximately 30% of the exams are composed of design questions where students are given a problem and must complete some aspect of the design process to solve the problem. These problems are often open-*

ended in nature with multiple feasible designs. Students are often required to consider some constraints such as cost of their designs. In lectures, the professor works through design examples regularly to illustrate the application of course concepts to the design of digital systems. A typical week of lectures will feature 1-2 design examples.

- *Both assessment and lecture/tutorial content exceed 40% ED and the course is similar in nature to ECE241 which is assessed at 50% Engineering Design.*

4.3. Update course description for Aerospace, Math Stats and Finance, Energy, and Robotics major.

PROPOSED addition to course description: CHE374H1 may be taken in 4F to provide increased flexibility in 3F for Aerospace, Math Stats and Finance, Energy and Robotics major.

- *To increase flexibility in 3F.*

4.4. Update course description for **ESC103H1F: Engineering Mathematics and Computation**

CURRENT course description: This course is designed to introduce students to mathematics in an engineering context, while exposing students to computational techniques. Topics include: vectors, lines and planes; 3-D visualization; matrices and transformations; matrix inverses, eigenvalues and determinants; solving linear systems; curve fitting and least squares; numerical integration and numerical solutions to differential equations. Course content is complemented with the use of MATLAB computational software.

PROPOSED course description: Introduces students to mathematics in an engineering context, In particular, linear algebra and computational techniques. Emphasis is placed on developing students' ability to visualize in 2-D, 3-D, and higher dimensions. Linear algebra topics include: vectors, lines and planes, viewing systems of linear equations using row picture and column picture, independence, dependence and column space, matrix multiplication and factorization ($A=CR$), solving linear systems using elimination, connecting rank and shape of a matrix, and inverse matrices. Computational problems include numerical integration, solving the least squares problem, and numerical solutions to initial value problems (IVP) and boundary value problems (BVP). Course content is complemented with the use of computational software.

- *Revised to match current content and remove reference to specific software.*

4.5. Changes to Majors

4.5.1 Aerospace

AER525H1F: Robotics

Add **MIE301: Kinematics and Dynamics of Machines** as a prerequisite and **MIE404: Control Systems I** as a co- or prerequisite and “or equivalent” to prerequisites.

- *Provides a path for MIE students to take the course since this course is listed as a technical elective for MIE students and there are multiple control/dynamics courses they can take.*

4.5.2 Biomedical Systems Engineering

Add **APS360H1: Applied Fundamentals of Deep Learning F/S** as a technical elective.

- *Course has been requested as a substitute for a technical elective many times over past few years and always approved so officially add to tech elective list.*

4.5.3 Mathematics, Statistics and Finance

Add **APS360H1: Applied Fundamentals of Deep Learning F/S** as a technical elective.

Add **CSC384H1: Introduction to Artificial Intelligence F/S** as a technical elective.

- *Courses have been requested as technical elective substitutes many times over past few years and always approved so officially add to technical elective list.*

4.5.4 Electrical and Computer Engineering

Add **APS360H1: Applied Fundamentals of Deep Learning F/S** as a technical elective.

Add **CSC413H1S: Neural Networks and Deep Learning** as technical elective.

- *Courses have been requested as technical elective substitutes many times over past few years and always approved so officially add to tech elective list.*

4.5.6 Robotics

Add **APS360H1: Applied Fundamentals of Deep Learning F/S** as a technical elective.

- *Courses have been requested as technical elective substitutes many times over past few years and always approved so officially add to tech elective list.*

Minor corrections to calendar to agree with actual delivery

4.6 **ESC470H1S: Energy Systems Capstone Design**

Change delivery from 0/0/5 to 0/0/2

4.7 **ESC471H1F: Engineering Science Capstone**

Change delivery from 0/0/5 to 0/0/2

4.8 ESC472H1S: Electrical and Computer Capstone Design

Change delivery from 0/0/5 to 0/0/4

4.9 ROB498H1S: Robotics Capstone Design

Change delivery from 0/0/5 to 0/0/3

4.10 MIE429H1F: Machine Intelligence Capstone

Change delivery from 0/0/5 to 0/0/3

4.11 MIE479H1F: Engineering Mathematics Statistics, and Finance Capstone Design

Change delivery from 0/0/5 to 0/0/3

4.12 BME489H1F: Biomedical Systems Engineering Design

Change delivery from 1/0/4 to 2/3/0

5. MECHANICAL & INDUSTRIAL ENGINEERING

5.1. Add MIE4XXH1: Fundamentals of Injury Biomechanics and Prevention

PROPOSED course title: MIE4XXH1 - Fundamentals of Injury Biomechanics and Prevention

PROPOSED year and term: 4W, as a Technical Elective (TE)

PROPOSED course description: Injury biomechanics uses the principles of mechanical engineering to understand how injuries occur in various body regions and the main approaches to prevent them. In this course, we will review the injury mechanisms at the tissue level and the injury criteria for the lower extremities, upper extremities, head, neck, and trunk. Topics in injury prevention methods through safety devices and safely designing the equipment will be studied as well as engineering design considerations in treating a skeletal injury. The course also covers the computational (finite element analysis, and statistical analysis) and experimental (mechanical testing of crash test dummies, artificial bones, PMHS, and ex-vivo specimens) research methods used in injury and orthopedic biomechanics. Students will have the opportunity to apply their learning in forensic biomechanics case studies, and design and analysis of protective equipment.

PROPOSED learning objectives:

1. Identify the main mechanisms of sustaining injuries in major anatomical locations (e.g., lower extremities, upper extremities, head, neck, and trunk).
2. Explain the considerations in creating injury criteria for the human body.
3. Outline the main mechanisms in injury prevention.
4. Discuss the engineering considerations in the treatment of a skeletal injury.
5. Describe and apply the methodologies used in injury biomechanics.
6. Analyse the injuries from a motor vehicle collision and determine if the sustained injuries could have been prevented if the protective measures were used.

7. Design an engineering solution to overcome a limitation in a piece of protective equipment used in the transportation system or sport and develop a plan for testing its effectiveness.

PROPOSED textbook: A compilation of instructor notes and slides and additional readings. All teaching materials will be provided to the students (pre-lecture skeleton notes, completed post-lecture notes, and reading material). The resources to use during the course will be posted on the course website.

For extra readings students can use the following textbook: *“Biomechanics of Injury”*, 3rd Edition, Ronald F. Zernicke, Steven P. Broglio, William C. Whiting, Human Kinetics.

PROPOSED AUs:

50% Engineering Science [ES]

25% Natural Sciences [NS]

25% Engineering Design [ED]

PROPOSED timing:

Lectures = 3 h / Lab = 0 h / Tutorials = 1 h. Total AUs = 42.7

PROPOSED prerequisites: CIV100, MIE100, MIE270, MIE222

PROPOSED exclusions: n/a

PROPOSED short course name: Injury Biomechanics

PROPOSED room requirements: Standard row seat, 50-student capacity

PROPOSED minors and certificates: Minor in Bioengineering (AEMINBIO)

- *Fills a current gap in the MEC 4th-year Bioengineering stream. Currently, MIE offers two core courses: (i) cell and tissue biomechanics, and (ii) biofluid mechanics. Bioengineering stream students must choose 1 of the 2 core courses. Cell and tissue biomechanics used to cover whole body movement, but no longer does. This has created a gap in our bioengineering stream. The current proposal for an injury biomechanics course was done in consultation with the “Mechanics and Materials” Teaching Group (TG Coordinator: Kevin Golovin) with direct input from mechanics and bioengineering faculty.*
- *In addition, there is potential synergy with the Faculty of Kinesiology and Physical Education (KPE), who in collaboration with MIE has interest in creating a “movement performance” certificate for engineering students as part of the Cross-Disciplinary Programs. KPE currently offers a course titled: KPE372 - Injury and Orthopaedic Biomechanics, but the proposed MIE course is more focused on forensic biomechanics and engineering aspects of injury biomechanics, including mechanical design of injury prevention equipment. All efforts will be made to*

coordinate with KPE372 instructors to avoid significant overlap if a Movement Performance certificate is established.

5.2. Add **MIE5XXH1: AI for Social Good**

PROPOSED course title: **MIE5XXH1 – AI for Social Good**

PROPOSED year and term: 4F, 500-level (grad students eligible to enrol) as a CS/HSS Elective

PROPOSED course description: The issue of design and development of AI systems that have beneficial social impact will be discussed and analyzed. The focus will not be on the mechanics of AI algorithms, but rather on the implementation of AI methods to address societal problems. Topics to be covered will include: Safeguarding of human interests (e.g., fairness, privacy) when AI methods are used; partnering of humans and AI systems to implement AI effectively; evaluation of AI assisted interventions; practical considerations in the selection of AI methods to be used in addressing societal problems. The issues that arise in implementing AI for beneficial social impact will be illustrated in a set of case studies aimed at creating beneficial social impact. Class activities will include lectures, seminars, labs, and take-home assignments.

PROPOSED learning objectives:

1. Ability to evaluate risks associated with the use of AI in practical applications
2. Awareness of ethics and privacy standards that AI implementations should meet
3. Ability to evaluate overall effectiveness of AI implementations
4. Ability to design appropriate human roles in human-AI interaction

PROPOSED textbook: <https://ai4sibook.org/> AI for Social Impact (Tambe, M., Fang, F. and Wilder, B., Editors).

PROPOSED AUs:

75% Complementary Studies [CS]

25% Engineering Design [ED]

PROPOSED timing:

3 hours per week Lectures

Four labs in total. Labs will run from weeks 3-6 of the course.

Lectures will be run as a one-hour lecture and then a separate 2-hour seminar each week. The lecture will provide an overview of the topic for the week and then the seminar will be a guided discussion of the reading. Labs will be 2-hour sessions.

Including labs total contact time will be 44.6 hrs total, or 3.66 hrs per week average (Total AUs = 40.6)

PROPOSED prerequisites: MIE223, MIE237, or Introductory Machine Learning or equivalent

PROPOSED exclusions: CSC 300 Computers and Society

PROPOSED short course name: Impactful AI

PROPOSED room requirements: TEAL room or Case study room

PROPOSED minors and certificates: Minor in AI Engineering (AEMINEAIEN)

- *An AI course that intersects with societal impact aligns well with the recent IND curriculum renewal that saw an increased emphasis on AI and applied ML. The proposal was developed by Prof. Mark Chignell, an expert in human factors and information technology, and was done in consultation with both our “Human Factors” and “Info Engineering” Teaching Groups. MIE is keen to provide leadership in the education of applied AI/ML, including its impact on society. Furthermore, the course is an ideal fit for the Minor in AI Engineering.*

5.3. Change course title, description, prerequisites, and recommended background for **MIE440: Design of Innovative Products**

CURRENT course title: **Design of Innovative Products**

PROPOSED course title: **Design of Effective Products**

CURRENT course description: Recently developed methods applied at different stages of the design process include: Identification of unmet/underserved user needs through a modified definition of lead users (those who experience needs in advance of the mainstream population) including identifying/studying lead users, identifying which lead-user needs are relevant to the general population; Roles of function and affordance in successful products; Obstacles of fixation and cognitive bias to creativity; Concept generation methods including TRIZ/TIPS (Theory of Inventive Problem Solving, use of unrelated stimuli and analogy (e.g., from biology); Configuration design methods including design for transformation, design for assembly and end-of-life, e.g., reuse, repair and recycling. Hands-on experience of these topics in lectures, tutorials, and labs support successful application of the methods for the course project, as well as future design activities.

PROPOSED 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).

Add prerequisite: **MIE221H1: Manufacturing Engineering**, or with instructor permission.

Recommended Background Courses:

MIE240H1: Human Factors Engineering (IE core)

MIE242H1: Foundations of Cognitive Psychology (IE core)

MIE243: Mechanical Engineering Design (ME core)

MIE315: Design for the Environment (ME core)

MIE345H1: Case Studies in Human Factors and Ergonomics (IE elective)

- *The revised title and course description more accurately describes what the course currently is (and has been) for a few years now. The prerequisite is needed because introductory manufacturing topics are discussed. Many students who took MIE440 in the past did not expect the level of manufacturing presented in the course, so the prerequisite is important to manage expectations. The recommended courses are meant to give students a better idea of what the course is about.*

5.4. Update course description for **MIE414: Applied Fluid Mechanics**

CURRENT course description: This course builds upon the material introduced in Fluid Mechanics I and connects it to a wide range of modern technical applications of fluid flow. Applications include the design of pipe and microfluidic networks, transient flow phenomena, characteristics of pumps, open channel flow and an overview of flow measurement techniques. Lectures are complemented by laboratory experiments on topics such as centrifugal pumps, flow transients and fluid flow in microfluidic chips.

PROPOSED course description: This course builds upon the material introduced in Fluid Mechanics I and focuses on technical applications of fluid flow. Discussed topics include the pressure drop in pipe and channel flow networks, transient flow phenomena, external flows, performance characteristics of different pumps and turbines, systems of flow networks and flow machines, and an overview of modern flow measurement techniques. Lectures are complemented by laboratory experiments on topics such as pipe/channel networks, flow transients, and flow machines.

- *There is declining enrollment due to several possible contributing factors. One may be the current description, which is outdated and does not reflect current topics. The other factor may be that the course is currently listed as a technical elective in MIE's "bioengineering" stream. Relisting it as a technical elective for*

“Energy and Environment” is in better alignment with course content and will better target the students choosing the “Energy and Environment” stream.

- 5.5. Change **MIE504: Applied CFD** Year 4 Technical Elective course offering from winter to fall term.

CURRENT term: Winter term

PROPOSED term: Fall term

- *The main reason for this is that our undergraduate cohort will benefit from taking CFD early in their 4th year so that they can properly use it in their Capstone project.*

- 5.6. Update prerequisites for **MIE311: Thermal Energy Conversion**

CURRENT Prerequisite: MIE210H1, MIE313H1

PROPOSED Prerequisite: MIE210H only (remove MIE313H1)

- *Students do not take MIE313 until 3W, the same time that they take MIE311, so MIE313 cannot be a prerequisite. MIE313 should either be removed or added as a co-requisite. Adding as a co-requisite is preferred if that option is available.*

- 5.7. Change course title and prerequisites for **MIE535H1 Electrification Through Electricity Markets**

CURRENT course title: Electrification Through Electricity Markets

PROPOSED course title: Electrification Via Electricity Markets

- *Previous title was too long and resulted in unnecessary abbreviation of words to fit into the character limits of the short title. The proposed shorter title eliminates the unnecessary abbreviation.*

CURRENT Prerequisite: MIE258 or equivalent

PROPOSED Prerequisite: CHE249 or CME368 or ECE472 or CHE374 or MIE358 or equivalent

- *Specifically listing the economics courses from other departments further clarifies to the students that any of these courses are acceptable as the prerequisite.*

5.8. Add exclusions for **MIE422: Automated Manufacturing**

PROPOSED exclusions: ECE470 and AER525

- *The Calendar currently states: “Students may take only one of MIE422H1 (Automated Manufacturing) or AER525H1 (Robotics)”. However, this is currently listed as a footnote in the Calendar rather than a clear exclusion. Explicitly listing AER525 as an exclusion would make it clearer for students. In addition, AER525 is currently listed as an exclusion for ECE470. If AER525 is an exclusion for ECE470 and also an exclusion for MIE422 (as proposed), then ECE470 must also be an exclusion for MIE422, by extension.*

5.9. Add exclusion for **MIE245 Data Structures & Algorithms**

PROPOSED exclusion: CSC373

- *There is significant overlap between CSC373 and MIE245, and we want to avoid IND students requesting to use CSC373 as a Technical Elective substitute. This concern was raised because a recent MEC student used CSC373 as a Technical Elective substitute, and that request was approved since they are a MEC student and MIE245 is not a core course for them. Since MIE245 is core to IND, and IND student should not also be eligible to take CSC373.*

5.10. 2024-2025 Curriculum Changes from Industrial Engineering Curriculum Renewal

The following changes were proposed as part of the completed IE Curriculum Renewal Package presented in whole by Prof. Scott Sanner to the FASE UCC in Fall 2022. The IE Curriculum Renewal involves a multi-year phased approach to curriculum changes. In Fall 2022, after the whole package was presented to and approved by the UCC, the first phase of curriculum changes affecting second year courses in the IND program were brought forth to Faculty Council to be implemented in 2023-2024.

In this cycle, for Fall 2023, we are presenting the second phase of curriculum changes, which will affect third year courses in the IND program. These curriculum changes are to be brought forth the Faculty Council in Fall 2023, to be implemented in 2024-2025.

Changes in the second phase:

5.10.1. Add the following courses:

1. **MIE3XXH1(F): Introduction to Machine Learning** (New Course)
2. **MIE3XXH1(S): Data Modelling** (Moved from 2nd year)
3. **MIE304H1(S): Introduction to Quality Control** (New TE, currently a MechE and MSE TE)
4. **MIE3XXH1(S)/MIE459: Organization Design** (Moved from 4th year – taught as two separate sections, double coded / equivalent courses to

accommodate both cohorts, **MIE459: Organization Design** to be dropped only in 2026-27 due to PEY)

5.10.2. Drop the following courses:

1. **MIE335H1(F): Algorithms & Numerical Methods** (Moved to 2nd year) – submitted in 2022, effective 2023-2024
2. **MIE364H1: Quality Control and Improvement** (Replaced by MIE304)

5.10.3. Changes to the following courses:

1. **MIE258H1(F) relabel as MIE358H1(F): Engineering Economics** (Moved from 2nd year to 3rd year, update Title and Description, notify MechE and MSE need to update their programs)
2. **CSC384H1(F): Introduction to Artificial Intelligence** (New Prerequisites) – submitted in 2022, effective 2023-2024
2. **MIE343H1(F): Industrial Ergonomics and the Workplace** (Now a Technical Elective)
4. **MIE344H1(F): Ergonomic Design of Information Systems** (New Description)
5. **MIE365H1(F): Advanced Operations Research** (New Title and Description)
6. **MIE350H1(S): Integrated Design: Human Factors and Information Systems** (New Term, Description)
7. **MIE354H1(S): Business Process Engineering** (New Term)
8. **MIE5XXH1(S): Electrification Through Electricity Markets** (Update Prereq: **MIE258: Engineering Economics and Accounting** to **MIE358**)

5.11. Detailed Course Requests

5.11.1. Add new core course **MIE3XXH1(F): Introduction to Machine Learning**

PROPOSED year and term: 3F

PROPOSED course description: Intro to Machine Learning, Hypothesis Spaces, Inductive Bias. Supervised Learning: Linear and Logistic Regression. Cross Validation (CV). Support Vector Machines (SVMs) and Regression. Empirical Risk Minimization and Regularization. Unsupervised Learning: Clustering and PCA. Decision Trees, Ensembles and Random Forest. Neural Net Fundamentals. Engineering Design considerations for Deployment: Explainability, Interpretability, Bias and Fairness, Accountability, Ethics, Feedback Loops, and Technical Debt.

PROPOSED learning objectives:

1. Understand fundamental supervised and unsupervised machine learning from a mathematical perspective.
2. Understand how to properly evaluate machine learning algorithms to assess generalization performance.
3. Understand conceptual and mathematical fundamentals of neural networks.
4. Understand key learning and optimization algorithms commonly employed for machine learning.
5. Understand how to identify and address ethical concerns of bias and fairness in

machine learning systems.

6. Understand common deployment requirements and problems that may occur at the deployment stage of machine learning algorithms.
7. Obtain hands-on lab and assignment experience applying machine learning to real-world datasets.

PROPOSED *Mathematics for Machine Learning*: Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong. Cambridge University Press (2020).

PROPOSED AUs:

75% Engineering Science

25% Engineering Design

PROPOSED timing:

Lecture: 3 hours / Lab: 2 hours / Tutorial: 0 hours

PROPOSED prerequisites: **MIE236H1/ECE286H1/STA286H1/ECE302H1** or equivalent, **MIE237H1/ECE286H1/STA286H1** or equivalent

PROPOSED exclusions: CSC411H1, ROB313H1, ECE421H1, ECE521H1

PROPOSED short course name: Intro to Machine Learning

PROPOSED room requirements: Windows or Linux Computer Lab for lab component

- *Machine Learning is a fundamental methodology in the use of data in the modern organization and is thus foundational to a modern IE curriculum.*

5.12. Change course code, description, year and term offering for **MIE253H1: Data Modelling**

CURRENT course code: **MIE253H1**

PROPOSED course code: **MIE3XYH1**

CURRENT year and term: 2S

PROPOSED year and term: 3F

CURRENT course description: This course provides an understanding of the principles and techniques of information modelling and data management, covering both relational theory and SQL database systems (DBMS), as well as entity-relation conceptual modelling. The course also familiarizes the student with analytical applications (OLAP) and provides an introduction to XML data modelling. The laboratory focuses on database application development using SQL DBMS, OLAP queries and entity-relation data modelling.

PROPOSED course description: This course provides an understanding of the principles and techniques of information modelling and data management, covering both relational theory and SQL database systems (DBMS), as well as entity-relation conceptual modelling. The course also provides an introduction to graph databases (RDF, SPARQL, and knowledge graphs), as well as UML class diagrams. The laboratory focuses on database application development using SQL DBMS, OLAP queries and data modelling.

- *The changes incorporate updated content on new technologies currently be used in industry.*

5.13. Add **MIE304H1(S): Introduction to Quality Control** as a technical elective option of Industrial Engineering

PROPOSED year and term: 3S/4S

- *This core course has been replaced by an existing MEC technical elective MIE304, in favour of more core content in higher demand data science areas.*

5.14. Change course code, description, year/term for **MIE459H1: Organization Design**

CURRENT course code: MIE459H1

PROPOSED course code: MIE3YYH1

CURRENT year and term: 4S

PROPOSED year and term: 3S

CURRENT course description: Study of work systems design in new and existing organizations. Consideration will be given to sociotechnical systems design methodology, division of labour, change management, teams, incentives, project management, safety culture, automation, equity, and union-management relations.

PROPOSED course description: Study of work systems design in new and existing organizations. Consideration will be given to fundamental organizational theory topics such as structure, lifecycle, culture, and ethics. These concepts will be the foundation for an understanding of concepts such as bureaucracy, incentives, innovation, international business, trends in technology, and hiring. An emphasis will be placed on applying these concepts to real-world organizational examples and case studies.

- *No major changes, instead the description now includes a sense of fundamental concepts and applied topics. A focus on applications and examples is now included.*

5.15. Change course code, title, description, year/term for **MIE258H1: Engineering Economics and Accounting**

CURRENT course code and title: **MIE258H1: Engineering Economics and Accounting**

PROPOSED course code and title: **MIE358H1: Engineering Economics**

CURRENT year and term: 2F

PROPOSED year and term: 3F

CURRENT course description: Engineering economic and accounting concepts needed in the design of engineering systems. Financial analysis topics include: financial statements, depreciation, income tax, and basic accounting techniques. Project analysis topics includes: time value of money, evaluation of cash flows, defining alternatives, analysis of independent projects, acceptance criteria, buy or lease, make or buy, replacement analysis, economic analysis in the public sector, project risk and uncertainty. Inflation concepts.

PROPOSED course description: This course provides students with knowledge and skills for understanding, analyzing, and solving decision making problems which involve economic concepts. These problems deal with deciding among alternatives in engineering projects with respect to costs and benefits over time. The overarching goal of the course is preparing engineers with the skills and knowledge for analyzing economic decisions quantitatively and making suitable decisions by acknowledging and incorporating the ramifications of factors like interest, depreciation, taxes, inflation, and risk in engineering projects.

- *This course has been revised with guidance from a new edition of a textbook, thus integrating some previously taught topics in modern decision-making needs. Emphasis is placed on quantitative analysis methods.*

5.16. Change **MIE343H1(F): Industrial Ergonomics and the Workplace** from a core course to a technical elective and update course description

CURRENT type: Core

PROPOSED type: Technical elective

CURRENT 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.

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.

- *Minor changes reflecting evolving emphasis of the course material.*

5.17. Update course description for **MIE344H1(F): Ergonomic Design of Information Systems**

CURRENT course description: The goal of this course is to provide an understanding of how humans and machines can be integrated with information systems. The focus will be on the design of human-machine interfaces, and on the analysis of the impact of computers on people. The course will also include coverage of usability engineering and rapid prototyping design, analysis of user mental models and their compatibility with design models, and quantitative modelling of human-computer interaction.

PROPOSED course description: Application of information and interaction design principles in interactive systems. Focus on design and methods for understanding user needs, making sense of user research, prototyping, evaluation methods and iterative design. The course will include in depth coverage of rapid prototyping, scenario-based design, usability inspection methods, summative and formative usability evaluation, and comparison tests. Eye tracking, remote testing and experience/ journey mapping will be introduced.

- *New course description better adheres to guidelines for course descriptions and reflects new course content and emphasis on an iterative design process.*

5.18. Change course title and description for **MIE365H1(F): Operations Research III: Advanced OR**

CURRENT course title: **Operations Research III: Advanced OR**

PROPOSED course title: **Advanced OR**

CURRENT course description: Design of operations research models to solve a variety of open-ended problems. Linear programming extensions are presented: goal programming, column generation, Dantzig-Wolfe decomposition, and interior point solution methods. Non-linear programming solution methods are developed: optimality conditions, quadratic programming and bi-level programming. Solutions to advanced stochastic models: stochastic programming, 2-person and n-person game theory, and Markov Decision Processes.

PROPOSED 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.

- *Natural evolution of course content with recognition to changes in MIE262 and MIE263.*

5.19. Change term offering and course description for **MIE350H1(s): Design and Analysis of Information Systems**

CURRENT year and term: 3F

PROPOSED year and term: 3S

CURRENT course description: Provides students with an understanding of the methods of information system analysis and design. These include methods for determining and documenting an organization's structure (FDD), activities, behaviours and information flows (DFDs, decision tables and trees, network diagrams, etc.); model acquisition (data repositories), verification and validation. Methods such as SADT, RAD and prototyping will be covered. Students will acquire a working knowledge of various frameworks for analysis (e.g., information technology categories, system and application classifications, decision types, data vs information). Throughout the course, emphasis is placed on the importance of systems thinking and organizational culture in the analysis and design process. In the laboratory, students will use a CASE-based computer program (Visible Analyst) for the analysis and design of information systems for selected organizations. Students will be asked to work in teams to create a web-based information site and to document and present their development progress through the use of a structured project log.

PROPOSED course description: The course covers the software lifecycle of user-centered, computer-based information systems. Topics include software development methodologies, requirement engineering, use case analysis, process modelling, data flow diagrams, UML, design, model-driven architecture, and implementation. The course will emphasize user-centered perspectives and effective communication across the software lifecycle of information systems.

- *This change is proposed as part of the larger changes in the IE curriculum. Course specific rationales: (i) more emphasis on human-centered aspects of systems design for increased integration of human factors perspective, (ii) update description to reflect recent tools and platforms. This proposal came out of discussions with Eldan Cohen (current instructor), Michael Gruninger and Chris Beck (previous instructors), and Greg Jamieson. There was a suggestion to change the name but after re-examining the proposed new curriculum, we now propose to keep the old one as it is still accurate.*

5.20. Change term offering, prerequisites, and course description for **MIE354H1(S): Business Process Engineering**

CURRENT year and term: 3F/4F

PROPOSED year and term: 3S/4S

CURRENT Prerequisite: **MIE253H1**

PROPOSED Prerequisite: **MIE3XYH1** (new course code for what was formerly **MIE253H1: Data Modelling**)

CURRENT course description: This course focuses on understanding multiple perspectives for grouping, assessing, designing and implementing appropriately integrated and distributed information systems to support enterprise objectives. The emphasis is on understanding how Business Process Management techniques and tools can contribute to align an organization's business and information technology perspectives, as well as the characteristics of application and system types and the implications for their design, operation and support of information needs, including those associated with different platforms and technology infrastructure e.g., legacy systems, client/server, the Internet and World Wide Web including the emergence of a web-service-based service oriented architecture. Students will work in the laboratory to develop business processes that can be specified and executed by information systems supporting BPEL, a widely supported standard for describing web-service-based business processes.

PROPOSED 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.

- *Blockchain and Web3 have been incorporated into the course content as a recent (disruptive) addition to the distributed information systems technologies that organizations can integrate with their Business Processes. The term has moved to accommodate the year change of the Data Modeling prerequisite.*

6. **MATERIALS SCIENCE & ENGINEERING**

6.1. Update course description for **MSE202: Thermodynamics I**

CURRENT course description: The three laws of thermodynamics, Heat capacity theory and Debye's law. Calculations of enthalpy, entropy, and free energy of pure materials and reactions. Reversible and irreversible processes. Gibbs free energy, chemical equilibria, and phase rule. Introduction of Ellingham, and pre-dominance area diagrams. Binary and ternary phase diagrams and their applications to materials processing and materials properties.

PROPOSED course description: Fundamental Thermodynamics Laws. Thermodynamic Variables and Relationships. Understanding Reversible and Irreversible Processes. Thermodynamic Equilibrium and the Gibbs Phase Rule. Exploring the Clausius-Clapeyron Equation. Practical Thermodynamic Applications for Unary Phase Diagrams. Multicomponent Multiphase Reacting Systems in Standard State. Analyzing the Ellingham Diagram and Pre-dominance Diagrams. Binary Phase Diagrams for Materials Processing and Properties.

- *Course description is being updated with new professors teaching the course.*

6.2. Update course description for **MSE302: Thermodynamics II**

CURRENT course description: Introduction to statistical thermodynamics. The concept of chemical potential and its application in solution thermodynamics. Solution models. Equilibrium in multi-component, multi-phase systems. Thermodynamics of surfaces and interfaces. Applied thermodynamics with examples of industrial applications. Computational thermodynamics.

PROPOSED course description: Ternary Phase Diagrams for Materials Processing and Properties. Introduction to Statistical Thermodynamics. Exploring the Concept of Chemical Potential in Solution Thermodynamics. Understanding Solution Models. Equilibrium in Multi-component Multi-phase Systems. Utilizing Thermodynamic Models for Creating Binary Phase Diagrams. Practical Applications of Thermodynamics with Industrial Examples. Analyzing Equilibrium Conditions in Electrochemical Systems and Their Practical Uses. Computational Thermodynamics for Advanced Understanding.

- *Course description is being updated with new professors teaching the course.*

6.3. Change course title and description for **MSE401: Materials Information in Design**

CURRENT title: Materials Information in Design

PROPOSED title: Materials Selection for Sustainable Product Design

CURRENT course description: This course presents approaches to composite and structural design, and optimization, for components and products. Tools for optimization, material property data analytics, and structural simulation will be used. We will apply advanced materials selection (and the CES materials database) to product and component design, and hybrid (composite) materials design. Composite mechanics theory and topology optimization will be developed for structural optimization. Finally, modern techniques including AI and machine learning will be presented for aspects of materials selection, composite design and structural optimization. Component design decisions will include both material properties and the capabilities of applicable fabrication processes, to identify the material and process which best satisfy the design requirements. Course objectives: (1) define the role that materials play in product design (properties, performance), (2) establish a rational, systematic means of comparing materials, and materials selection by applying design constraints and optimize mechanical performance, (3) learn to apply software tools (CES) for materials selection, (4) find compromise with multiple constraints, (5) perform iteration in the optimization of product design, considering materials, shape and processing, (6) design new products based on multiple components, considering optimal performance, manufacturing and environmental sustainability.

PROPOSED course description: Provides a rationale for materials selection in the design of engineered components and commercial products, with a general aim towards structural optimization and sustainability. Defines concepts of life cycle analysis and embodied energy, reviews material recycling technologies and methods, and environmental issues associated with materials in manufactured products, and waste. Develops a rationale for advanced materials selection, using the Ansys Granta CES materials software (a database for thousands of materials), for component design, based on an identification of the functional requirements. Develops a method for 'eco-audit' estimation of the total embodied energy of products. Altogether, materials selection includes structural and material processing considerations, and a range of case studies provide examples of optimized and sustainable design. Hybrid (composite) materials design and options for sustainable bio-composites discussed, including basic composite mechanics and topology optimization for structural optimization. There are two main design projects associated with proposed products, involving materials selection and multiple component design, to demonstrate an optimization of material usage and overall product sustainability. Course objectives: (1) Define the role that materials play in product design (properties, performance); (2) Define the embodied energy and sustainability of materials and products; (3) Establish a rationale for materials selection (a material index) by defining a design objective and constraints to optimize structural efficiency and sustainability; (4) Learn to apply software tools (Ansys CES) for materials selection; (5) Find compromise with multiple constraints; (6) Perform iteration in the optimization of product design, considering materials, shape and processing; (7) Design a device/product with multiple components, considering optimal performance, manufacturing and environmental sustainability.

- *Course description is being updated with new professors teaching the course. Course title is being updated to better reflect actual course content.*

6.4. Change **MSE343: Biomaterials** Year 3 Elective and **MSE443: Composite Materials Engineering** Year 4 Core course offering from Fall to Winter Term.

As a result of the change to **MSE443: Composite Materials Engineering**, a Winter Term Technical Elective will shift to Fall Term

- *In hopes of increasing enrolment due to limited elective spaces in current term offered (MSE343) and to return course offering to its historical term (MSE443).*

6.5. Remove one GA from **MSE332: Heat and Mass Transfer for Materials Processing** course information.

CURRENT GAs: 1C Knowledge Base for Engineering – Developed
1D Knowledge Base for Engineering – Developed
2A Problem Analysis – Developed

PROPOSED GAs: 1C Knowledge Base for Engineering – Developed
1D Knowledge Base for Engineering – Developed

- *Removing a GA from current course information to better reflect actual course content.*

6.6. Change course code for **MSE443/MSE1043: Composite Materials Engineering**

CURRENT course code: **MSE443/MSE1043**

PROPOSED course code: **MSE543**

- *For administrative purposes, changing double coded course to 500-level.*

6.7. Expand elective offering for **MSE465: Application of Artificial Intelligence in Materials Design** to Year 3 Students

CURRENT elective offering: Year 4 Fall Term.

No recommended preparation listed.

PROPOSED elective offering: Year 3 and Year 4 Fall Term.

Recommended preparation: strong background in math, programming, AI, and machine learning.

- *To provide students with more elective options in Fall Term and responding to students' requests, and addition of recommended preparation term.*

6.8. Increase tutorial time for **MSE335: Materials Physics**

CURRENT course offering: 3 LEC hours and 1 TUT hours each week.
Two separate TUT sections.

PROPOSED course offering: 3 LEC hours and 2 TUT hours each week.
One TUT section.

- *Currently two separate 1-hr tutorial sections, however, students expressed benefits in having more contact hours/longer tutorial sessions.*

6.9. Remove **MIE364: Quality Control and Improvement**

- *Course will no longer be offered.*

6.10. Change course code for **CHM325: Introduction to Inorganic and Polymer Materials Chemistry** to **CHM355: Introduction to Inorganic and Polymer Materials Chemistry**

- *Course code change from FAS.*

6.11. Correct course weight of **MSE353**: from 0.25FCE to 0.5 FCE

- *This error was a typo in the system.*

6.12. Combine two low weighted courses into one in each term.

- **MSE296: Materials Paradigm at a Glance I** - 0.15 credits plus **MSE294: Communications I** – 0.25 credits in Fall and
- **MSE297: Materials Paradigm at a Glance II** – 0.15 credits plus **MSE295: Communications II** – 0.25 credits in Winter

PROPOSED weighting of combined courses: 0.5 credit each semester

PROPOSED Timing:

1/0/2 – One hour of lecture, two hours of seminar/workshop

PROPOSED Title: **Materials Thinking and Communication I & II**

PROPOSED Prerequisites: MSE29X should be prerequisite for MSE29Y

CURRENT course description for **MSE294/295: Communications I/II**: This is part I/II of two laboratory, tutorial, and lecture courses building on the communication principles students learned in first year. Students will work in teams on open-ended design projects, and scaffolded assignments will provide students the opportunity to report on their projects in written reports, podium presentations, and poster presentations. The projects in this course are supported by laboratory exercises and tutorial activities.

PROPOSED course description for **MSE294/295: Communications I/II**: Materials come in all sorts of forms and exhibit a wide range of behaviours, yet there is more in common to their explanation than there is difference. Materials thinking involves recognizing how various ways of understanding materials work together in a holistic materials paradigm. MSE29X & MSE29Y will put the threads from the second year curriculum into a common informational framework more reflective of the emerging state-space based approach to materials thinking. In addition to supporting students in building a holistic understanding of materials science, these courses also build on the principles of engineering communication students learned in first year. We challenge students to develop their understanding of materials science through assignments that use key forms of engineering communication (writing, oral presentations, visual representations). We use critical self-reflection and analysis to help students learn materials thinking, improve their communication and teamwork skills, and develop metacognitive and self-regulated learning skills.

CURRENT course description for **MSE296/297: Materials Paradigm at a Glance I/II**: Materials come in all sorts of forms and exhibit a wide range of behaviors, yet there is more in common to their explanation than there is difference. MSE296 & MSE297 will put the threads from the second year curriculum into a common informational framework more reflective of the emerging state-space based materials paradigm. This course will meet on a biweekly basis. Credit is obtained by participating in in-class exercises.

PROPOSED course description for **MSE296/297: Materials Paradigm at a Glance I/II**:
As above.

7. INSTITUTE FOR STUDIES IN TRANSDISCIPLINARY ENGINEERING EDUCATION & PRACTICE

7.1. Add new course TEP 4XX

PROPOSED course title: **To Engineer is Human**

PROPOSED course description: Behind every engineering feat is a human story. Students will learn to examine this often-overlooked aspect of engineering and its implications for engineering work. Engineering is at its core a humanist enterprise: a human activity geared at helping to attain human goals, which requires the integration of many viewpoints, technical and non-technical. The course begins by examining the human condition, starting from the complexity of individuals and leading to how certain social dynamics manifest. It then builds a foundation for appreciating and engaging in the interdisciplinary work that engineering entails by examining conceptions of engineering, as well as the humanities and social sciences (e.g. sociology, anthropology, history) and their intersections with engineering. These themes are then integrated to explore the core topic of engineering as a human activity and its implications for engineering work.

PROPOSED level of instruction: Undergraduate (with dual code Graduate)

PROPOSED delivery: Fall term
 3 Lecture, 1 Tutorial
 In Person

8. CROSS-DISCIPLINARY PROGRAMS

8.1. New Courses:

APS441H1 S - System-Theoretic Accident and Risk Analysis for Winter 3/0/1/0.5

AECERFORE

Provides new perspectives on safety and human error and shows how to incorporate humans in complex automated systems using systems thinking. Risk assessment of a sociotechnical system identifies hazards that can result in human, material or environmental losses, the likelihood of such hazardous events, and their consequences. This project-based course combines theory and practice to present a system-theoretic approach to risk assessment.

APS495Y1 Y - Summer Research for Visiting Students(As discussed at Oct 7 mtg, this course will ONLY be for incoming summer exchange students)

An independent research project conducted in an engineering laboratory for students from an approved partner institution for 10-16 weeks in the summer term. This course is intended for students who will have completed their 2nd or 3rd year of study by the time they take the course. Students must apply for this program through their home university and will be approved via the Centre for International Experience if they are accepted. For more information, please contact URIE@engineering.utoronto.ca

APS500H1 – Negotiations in an Engineering Context

Changing Recommended Preparation to Pre-Requisite - "JRE420 or equivalent, or instructor permission"

APS330H1 – Interdisciplinary Studies for Sustainability and Innovation:

Changes to calendar entry regarding application process:

Current: Admission to this course will be by application conducted in the Fall. The schedule for this course will be determined in the Fall in consultation with the participating universities. Students will be able to select the section that best fits their schedule.

New: Admission to this course will be by online application, which will be available starting in June. Initial round of applications will be reviewed prior to the course enrollment date and on a periodic basis after that if spaces become available.

Current Prerequisite: Must have completed at least 10.0 FCE in their current engineering degree program prior to the start of the course. Approval of department

New: Must have completed at least 10.0 FCE in their current engineering degree program prior to the start of the course. Approval of the student's application for the course.

APS521H1 - Building Organizations: An Engineers Business Toolkit

Removing pre-req of JRE300, JRE410; Adding JRE300 as Recommended Preparation

APS440H1 – Making Sense of Accidents

Term switch from Winter to Fall, to provide better sequencing with new APS441H1 S

APS360H1 – Applied Fundamentals of Deep Learning

Changing delivery from 3 LEC / 1 TUT to 3 LEC / 1 PRA (requested switch based on room usage and current course delivery)

APS510H1 – Innovative Technologies and Organizations in Global Energy Systems

Remove exclusion of APS310, which no longer exists and has been removed from the calendar.

8.2. Changes to existing programs:

Bioengineering Minor

Add to “As Needed” category:

- HPS346H1 - Modifying and Optimizing Life: on the Peculiar Alliance between AI, Biology, and Engineering – accidentally left out when minor was modified last year
- MIE4XXH1 – Fundamentals of Injury Biomechanics and Prevention (new course MIE)

Environmental Engineering Minor

Add as Advanced Elective:

- MSE401 - Materials Selection for Sustainable Product Design (as discussed with MSE, approved by Director)

AI Engineering Minor

Add to Requirement 5 (Focused electives)

- HPS340H1 – The Limits of Machine Intelligence (approved by Director)
- CSC412H1 – Probabilistic Learning and Reasoning (approved by Director)
- MIE5XXH1 – AI for Social Good (new course MIE)

Engineering Music Performance Minor and Music Technology certificate

Changes to the wording with respect to MUS elective courses – The Faculty of Music has different MUS course offerings each year (revolving list) offered through the Faculty of Arts & Science. Their course offering are determined after our calendar change deadline, thus we are

continually out of date. We will allow any MUS as an elective course except MUS vocal and instrumental performance courses.

Current entry: lists individual MUS courses.

New entry:

Elective Courses

HMU111H1: Introduction to Music and Society

TMU131H1: Music Theory 2

Any cultural or historical MUS course (excluding vocal and instrumental performance courses).

Course offerings are updated annually in the Faculty of Arts and Science calendar.

Engineering Business Minor, Engineering Business Certificate and Entrepreneurship Certificate

Remove MIE258 in place of MIE358 (Engineering Economics updates from MIE)

Forensic Engineering Certificate

Add to electives:

APS441H1 - System-Theoretic Accident and Risk Analysis (new course from CDPO)

Renewable Resources Certificate

Add to electives:

CIV5XXH1 – Design of Timber Structures (new course from CIV/MIN)

Justice Equity Diversity and Inclusion Certificate

Add to Technology and Society elective group:

TEP4XXH1 – To Engineer is Human (new course from ISTEP)

Engineering Leadership Certificate

Add to electives:

TEP4XXH1 – To Engineer is Human (new course from ISTEP)



UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

Report No. 3756

MEMORANDUM

To: Executive Committee of Faculty Council (November 14, 2023)
 Faculty Council (December 7, 2023)

From: Professor Lisa Romkey
 Chair, Engineering Graduate Education Committee (EGEC)

Date: November 7, 2023

Re: Engineering Graduate Education Committee Information Update

REPORT CLASSIFICATION

This is a routine or minor policy matter that has been approved by the Engineering Graduate Education Committee (EGEC). It will be considered by the Executive Committee for approval and forwarding to Faculty Council for information.

NEW COURSES APPROVED

<p>MIE1520</p>	<p>Learning with Graphs and Sequences: Complex data in a variety of applications can often lend themselves to a sequence or graph representation. In recent years, many tools and techniques were developed to efficiently learn from sequence and graph data. In particular, specialized deep neural network architectures, such as graph neural networks and transformers, have obtained state-of-the-art performance in tasks such as natural language processing and recommender systems. This course will provide students with advanced conceptual, theoretical, and implementational skills for developing machine learning approaches for processing sequences and graphs. The course will cover the design and training of both fundamental models and recent state-of-the-art models, and will prepare student to conduct research that involves the development or application of machine learning techniques for sequences or graph data. Knowledge of machine learning, algorithms, and programming is required, while knowledge of deep learning is recommended.</p>
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RECOMMENDATION FOR FACULTY COUNCIL

For information.



UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

Report No. 3754R

MEMORANDUM

To: Executive Committee of Faculty Council (November 14, 2023)
Faculty Council (December 7, 2023)

From: Professor Evan Bentz
Chair, Undergraduate Curriculum Committee

Date: November 3, 2023; revised November 13, 2023

Re: **Sessional Dates for Fall 2024 – Winter 2029**

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 AND CONSULTATION

Beginning in the 2024-2025 academic year, first entry undergraduate divisions at the University of Toronto will be aligning sessional dates. This decision was made in consultation with representatives from all participating divisions and approved by the Council of First Entry Deans. The alignment of sessional dates is intended to reduce confusion, improve co-ordination of shared services and ensure consistent terms for students and faculty studying and working across divisions.

As a result of this change, the start of Fall term classes will move to the first Tuesday immediately following Labour Day. The start of Winter Term classes will normally be set to start on a Monday. There will be a minimum of 60 instructional days (12 weeks) in a term. Instructional days exclude Saturdays, Sundays and statutory or University holidays.

There will be a minimum of 12 calendar days for final exams in each term.

“Flex days” will be scheduled between the last day of classes and the start of the exam period in the Fall and Winter terms. These can be used as additional instructional days or study days, as determined by the Division. In addition, Divisions can use 1-2 days at the start of the exam period for study days if unable to utilize the flex days outlined below.

The sessional dates for Fall 2024 – Winter 2029 are:

Direct-Entry Programs: Five Year Sessional Dates					
Fall Term	F 2024	F 2025	F 2026	F 2027	F 2028
Labour Day	Monday Sept 2	Monday Sept 1	Monday Sept 7	Monday Sept 6	Monday Sept 4
Start of Fall Term	September 1	September 1	September 1	September 1	September 1
Start of Fall Classes	September 3	September 2	September 8	September 7	September 5
Fall Break	October 28 - Nov 1	October 27 - 31	October 26 - 30	October 25-29	October 30-Nov 3
End of Fall Classes	December 3	December 2	December 8	December 7	December 5
Flex days/study days	December 4-5	December 3-4	December 9	December 8-9	December 6-7
Start of Fall Exams	December 6	December 5	December 10	December 10	December 8
End of Fall Exams	December 23	December 23	December 23	December 23	December 22
End of Fall Term	December 23	December 23	December 23	December 23	December 22
Winter Term	2025	2026	2027	2028	2029
New Years Day	Wednesday Jan 1	Thursday Jan 1	Friday Jan 1	Saturday Jan 1	Monday Jan 1
Start of Winter Term	January 6	January 5	January 6	January 6	January 4
Start of Winter Classes	January 6	January 5	January 11	January 10	January 8
Winter Break	February 17-21	February 16 - 20	February 15-19	February 21-25	February 19-24
End of Winter Classes	April 4	April 6	April 12	April 7	April 9
Flex days/study days	April 7-8	April 7-8	April 13	April 8-10	April 10-11
Start of Winter Exams	April 9	April 9	April 14	April 11	April 12
End of Winter Exams	April 30	April 30	April 30	April 28	April 30
End of Winter Term	April 30	April 30	April 30	April 28	April 30

As the Faculty will no longer be setting sessional dates, it is important that we make use of the flexibility within the aligned sessional dates to ensure that each term meets our requirements for accreditation.

PROPOSED

We propose that the length of the standard term in Engineering be set at 12.2 weeks. In terms where the aligned instructional dates are less than 12.2 weeks, flex days will be used as instructional days. For example, in Winter 2025, April 7 will be used as an instructional day. This will ensure that both terms are the same length and that we have the same length of terms from year to year.

RECOMMENDATION FOR COUNCIL

THAT the length of the standard term in Engineering be set at 12.2 weeks, as described in Report 3754 Revised.



UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

Report No. 3758

MEMORANDUM

To: Executive Committee of Faculty Council (November 14, 2023)
 Faculty Council (December 7, 2023)

From: Prof. Sarah Haines
 Chair, Undergraduate Admissions Committee

Date: November 10, 2023

Item: Admissions Cycle 2023

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.

RECOMMENDATION FOR FACULTY COUNCIL

For information.

2023 ADMISSIONS CYCLE

This report will provide a summary of the activities of the Undergraduate Admissions Committee for the period November 1, 2022 to November 1, 2023.

Applications for Admissions

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

Offers of Admission

Year	2021		2022		2023	
Total Offers	4298		4447		4640	
Female Offers	1688	39%	1719	39%	1770	38%
OSS Offers	2307	54%	2255	51%	2328	50%
Non-OSS Offers	1991	46%	2192	49%	2312	50%
Domestic Offers	2695	63%	2786	63%	2808	61%
International Offers	1601	37%	1661	37%	1832	40%

Registration Figures

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

*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 2023. This was the final IFP incoming class.

Characteristics of the First Year Class 2023

Program	FT	PT	Total	non-OSS	OSS	IFP	# Women [^]	% Women	Domestic	Int'l	Mean OSS Avg
Chemical	135	6	141	59	82		51	36%	94	47	94.1
Civil	114	3	117	31	85	1	40	34%	96	21	94.4
Computer	192	1	193	60	133		72	37%	152	41	96
Electrical	132		132	69	62	1	48	36%	74	58	95.5
EngSci	297		297	89	208		119	40%	208	89	97
Industrial	73		73	30	42	1	40	55%	44	29	94.7
Materials	54	2	56	22	33	1	16	29%	27	29	93
Mechanical	155	2	157	89	68		64	41%	98	59	95.5
Mineral	25	1	26	16	10		5	19%	21	5	92.7
Track One	177	1	178	62	116		64	36%	134	44	94.9
Total	1354	16	1370	527	839	4	519	38%	948	422	95.4

* 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 2023 admissions, the OUAC allowed additional gender categories. Women includes students self-reporting as 'female' and 'trans-woman'