

Final Assessment Report

Mechanical Engineering (BASc), Mechatronics Engineering (BASc), and Mechatronics (Option)

September 2022

Executive Summary

External reviewers found that the Mechanical Engineering (BASc), Mechatronics Engineering (BASc), and Mechatronics (Option) programs delivered by the Department of Mechanical and Mechatronics Engineering were in good standing.

The overall assessment is that the programs are of very high quality...The program is thorough, and the course topics are appropriate, a mix of modern practical skills and traditional fundamental theory...The Co-op program is very successful, with very high placement rates.

A total of seven recommendations were provided by the reviewers, regarding TA assessments, curriculum review, and commitment to continuous improvement. In response, the program created a plan outlining the specific actions proposed to address each recommendation as well as a timeline for implementation. The next cyclical review for this program is scheduled for 2027-2028.

Enrollment over the past three years

| | Mechanical Engineering Honours Co-op | Mechatronics Engineering Honours Co-op | Mechatronics Option |
|-----------|---|---|--------------------------------|
| 2021-2022 | 1033 | 1101 | 33 |
| 2020-2021 | 1058 | 1084 | 22 |
| 2019-2020 | 1057 | 1047 | 14 |

Based on Active Student Extract in Quest, accessed September 15, 2022.

Background

In accordance with the University of Waterloo's Institutional Quality Assurance Process (IQAP), this final assessment report provides a synthesis of the external evaluation and the internal response of the Mechanical Engineering (BASc), Mechatronics Engineering (BASc), and Mechatronics (Option) delivered by the Department of Mechanical and Mechatronics

Engineering. A self-study (Volume I, II, III) was submitted to the Associate Vice-President, Academic on February 12, 2021. The self-study (Volume I) presented the program descriptions and learning outcomes, an analytical assessment of the programs, including the data collected from a student survey, along with the standard data package prepared by the Office of Institutional Analysis & Planning (IAP). The CVs for each faculty member with a key role in the delivery of the program(s) were included in Volume II of the self-study.

From Volume III, two arm's-length external reviewers were selected by the Associate Vice-President, Academics: Dr. Bruce Minaker, Associate Professor of Mechanical, Automotive and Material Engineering, University of Windsor, and Dr. Mina Hoorfar, Dean of Engineering and Computer Science, University of Victoria.

Reviewers appraised the self-study documentation and conducted a virtual site visit to the University from February 8, 2022 – March 4, 2022. An internal reviewer from the University of Waterloo, Dr. Christine Purdon, Professor of Psychology, was selected to accompany the external reviewers. The visit included interviews with the Associate Vice-President, Graduate Studies and Postdoctoral Affairs (on behalf of the Associate Vice-President Academic); Dean of the Faculty of Engineering; Faculty Associate Dean of Undergraduate Studies; Chair/Director of the Department, as well as faculty members, staff and current undergraduate students. The Review Team also had an opportunity to meet with representatives from the library, and Co-operative Education.

Following the site visit, the external reviewers submitted a report on their findings, with recommendations. Subsequently, the program responded to each recommendation and outlined a plan for implementation of the recommendations. Finally, the Dean responded to the external reviewers' recommendations, and endorsed the plans outlined by the program.

This final assessment report is based on information extracted, in many cases verbatim, from the self-study, the external reviewers' report, the program response and the Dean's response.

Program Characteristics

[Mechanical Engineering \(BASc\)](#) is one of the oldest disciplines of engineering. It continues to rapidly evolve and expand, to embrace new areas that include artificial intelligence, autonomous vehicles, robotics, micro electromechanical systems (MEMS), nanotechnology, and human-machine interface. Mechanical engineers design the systems that heat and cool buildings; the vehicles in which we travel; the power plants that generate electricity; and the processes used to manufacture virtually every product.

[Mechatronics Engineering \(BASc\)](#) is an interdisciplinary field that integrates the design principles and practices of Mechanical, Electrical, Computer, and Systems Design Engineering, and thus provides a comprehensive base from which graduates can work and communicate collaboratively

within and across disciplines. The evolution of electronics, materials, artificial intelligence, and computing has influenced industry in many ways that span from computer-controlled machines, to intelligent and autonomous systems, to smart sensors and wearables, among other applications.

The [Mechatronics Option](#) is one of the most popular options available to mechanical engineering students, reflecting the increasing prevalence of integrated mechanical, electrical, and computer systems in the [Industry 4.0 workplace](#) of advanced manufacturing, the (industrial) Internet of Things (IoT), smart cities, etc. This Option is primarily intended for students in Computer, Electrical, Mechanical, and Systems Design Engineering. For Mechanical Engineering students, in addition to the core mechanical engineering curriculum, students must take four additional core courses and one elective course with various offerings of the necessary five courses by the MME Department, Electrical and Computer Engineering Department, and Systems Design Engineering Department.

Summary of Strengths, Challenges and Weaknesses based on Self-Study

Strengths

- **Program Size:** The University of Waterloo (UW) has the largest Mechanical and Mechatronics Engineering (MME) program across Canada in terms of enrolled students and is taught by the largest number of full-time faculty. The size and technical diversity of the faculty is reflected in the wide variety of technical electives, options, and specializations available to the students. While all faculty are invested in undergraduate education, the Department has seven full-time continuing lecturers who are dedicated to delivering the undergraduate curriculum. These lecturers work with four technical staff, organized into a dedicated ‘teaching technical staff’ group. These personnel facilitate hands-on, self-directed learning through the MME Clinic, help deliver the engineering design component of the curriculum (e.g., assist student teams with their capstone design projects), and develop laboratories and other educational material.
- **Diversity and gender equity:** As Canada’s largest Mechanical Engineering program, they play a key role in increasing the diversity and inclusivity of their profession. Of the 61 teaching faculty in the MME Department, 11 are women. While this is still low, the program is pleased with their progress to date since this ratio is among the highest gender ratios for any mechanical engineering program in the country. The diversity of their faculty has been achieved through proactive recruitment at the Departmental level, and hiring practices designed to promote equity and diversity in the workplace. Similar activities in undergraduate recruitment have been successful: the number of women in their undergraduate class has steadily increased from approximately 10% in 2009 to 20%

in recent years. Efforts on this front, on LGBTQ+ outreach (Making Spaces, etc.), and on outreach to other groups including BIPOC populations are ongoing. There is still a long way to go to achieve equitable faculty, staff, and student populations. One of the many challenges to this work is included below.

- Hands-on and project-based learning: Coursework is balanced with hands-on and open-ended learning activities at all stages of the undergraduate program. These activities are supported by the MME Clinic, staffed by members of the teaching technical staff, who inspire student self-driven learning through authentic hands-on, practical engineering activities that promote integration between topics, courses and programs.
- Co-operative education: The University of Waterloo's mandatory co-operative program is a key strength of the program's undergraduate training, and is related to the Experiential Learning and Awareness of Limitations UDLEs. During their five/six mandatory work-terms (more than any other school in Canada, and required of all students compared to optional co-op in most other schools), students learn to function and communicate in a professional workplace and to solve real-world engineering problems. Co-operative education also makes employers active participants in the undergraduate pedagogical process. Not only do the employers directly train students during their co-op placements, but they also provide feedback to the Department about strength and weaknesses in the preparation of the students, information that is incorporated into the program's continual improvement process. Ultimately, many of the employers hire co-op students into full-time, permanent positions.
- Entrepreneurship: The undergraduate program places a particularly strong emphasis on entrepreneurship. Waterloo's entrepreneurship ecosystem is fueled by its unique creator-owned intellectual property policy ([Policy 73](#)), meaning that any ideas developed by the students (e.g., through the eight-month capstone design projects) belong exclusively to the students. Many of these projects have matured into engineering patents that have been purchased and commercialized by other companies or have instigated their own spin-off companies. The program's curriculum equips entrepreneurially-minded students with the knowledge base and skillset they need to commercialize their ideas. At the Department level, the eight-month capstone design experience includes modules on intellectual property and the patenting process, and a special award category recognizes projects with high commercial potential. At the university level, the [Velocity](#) start-up incubator is designed to give students the resources they need to commercialize their ideas, which include mentors, equipment, space, and a network. The Waterloo Entrepreneurship Residence Connection is another key part of this landscape, which include live-in Entrepreneurs-in-residence who provide one-on-one

mentoring, and a number of other activities that help students develop into successful entrepreneurs.

Challenges

- Diversity and gender equity: There is a well documented '[leaky pipeline](#)' of women potentially interested in Engineering, in that many more young women take Grade 10 academic science than take the required Grade 12 pre-requisites for admission to Engineering. This pipeline continues to leak in terms of those young women who choose to apply, accept, and continue their degrees. There is also a time lag of many years between an increase in student enrollment in UG programs and a progression to the PhD and potential faculty level. Neither MME nor Waterloo Engineering, nor UW can increase interest in mechanical and mechatronics engineering among high school girls by themselves. Nor can the program single-handedly increase the pool of qualified female PhDs. Similar challenges exist for increasing representation from other groups such as BIPOC populations. The program is happy to support IBET, WiE, and similar initiatives, and will continue this work, but it is challenging, and likely requires work at the Provincial and Federal level, and in industry, in changing the messaging and culture in high schools and industry.
- Student laboratories: Some of the laboratory facilities are out-of-date and require renewal. Limited resources for the purchase, maintenance, and storage of lab equipment make this a challenging problem to solve.
- Academic integrity: New communication technologies and the proliferation of internet-banked assignments and lab reports present new challenges to academic integrity that must be overcome.
- Student wellness/resiliency: The Mechanical and Mechatronics Engineering undergraduate programs are a challenging experience for undergraduate students, and often involves long working hours under intense pressure. While these conditions are formative, and help students develop organizational and time management skills, there is an increasing appreciation that they can also adversely affect mental and emotional wellbeing.

Weaknesses

Several areas of instruction have been identified as relatively weak. These include:

- Investigation (less present in the curriculum, related to the Knowledge of Methodologies UDLE)

- Communication (uniformly identified as an area of concern by faculty, students, and employers)
- Professionalism (less present in the curriculum, related to the Autonomy and Professional Capacity UDLE)
- Impacts (less present in the curriculum, related to the Autonomy and Professional Capacity UDLE)
- Ethics (less present in the curriculum, related to the Autonomy and Professional Capacity and Equity UDLEs)

Summary of Key Findings from the External Reviewers

The overall assessment is that the programs are of very high quality. The admission standards are very competitive and academic credentials of admitted students are very strong. The program is thorough, and the course topics are appropriate, a mix of modern practical skills and traditional fundamental theory. The assessments are rigorous and require evidence of competence. The Co-op program is very successful, with very high placement rates. The instructors are highly qualified. During the visit, external reviewers were impressed with the transparency and frankness of most of their discussions, particularly those with students, which they believe has facilitated an easy consensus on the overall position of the MME programs, its central-- even crucial--role in the University, and a relatively straightforward identification of strengths and weaknesses leading to recommendations on a path forward.

Major strengths

Reviewers identified several areas of strength in the program:

1. The reputation for academics is excellent. Waterloo is consistently identified as a destination of choice for particularly gifted students.
2. The faculty is directly involved in the admission process. This allows the faculty to exert more control in ensuring that the University is enrolling only the most qualified students, and self-determination of the appropriate target enrollment number. Further, it fosters enhanced use of the application data for evaluation of external factors that may influence the students' decision to accept offers of admission, and their likelihood of success (e.g., the distance from home address to the city of Waterloo).
3. The university is constantly moving towards the improvement of the students' experience, e.g., they have an external reviewer to evaluate the cultural dynamics and students' "ownership" of the program. They provide an extensive array of counselling and advising services. At the same time, the changes made to the program to improve the students' experience are implemented with an eye to keeping the reputation for academic rigor intact.

4. The program has a very active and supportive decentralized in-house IT services. They provide an impressive range of support for a variety of issues ranging from research data storage, website delivery, in-classroom AV, and student software tools.

The MME programs are well aligned with the university strategic framework, more specifically around commitment towards:

1. EDI: There is a strong mandate towards EDI; the department is very progressive and has achieved great milestones towards female inclusion in engineering. Also, they have established an anti-racism task force and plans are in place for a cluster hire of Black and Indigenous faculty members. With the support from the Dean, the IBET pathway for PhD students has been launched. There is also an elder in residence helping with the design and implementation of indigenous contents in the curriculum. As part of the EDI mandates, a wellness coordinator has been hired, whose support has significantly improved students' experience and retention in the program. In addition, there is a very strong peer mentorship program which stems from the collegiality ethos being promoted and observed among students.
2. Interdisciplinary studies: this is seen in many areas such as the commitment towards the Canadian Grand Challenges and their reflection in the design courses and the incubator established for entrepreneurship where 4th year students work along with the students from Business.
3. Novel and active curriculum: The first-year program has some innovative features that are very targeted towards engaging the student body in challenge-based learning, with the focus on cognitive development in engineering design. There is an interest in lessons learned from the remote delivery mode (performed during the pandemic), and in blended learning (involving high quality interaction and student centric learning). Another feature of the programs is "The Ideas Clinic" (run by students) facilitating and promoting challenge-based learning in the courses and intersection between the courses. Finally, the five professional development (PD) modules of the co-op programs are exemplary.

Areas for improvement and opportunities for enhancements

The opportunities for enhancement can be considered at the faculty and program levels. At the Faculty level, the areas where concerns were observed include:

1. Direct entry: the lack of the common first year adds additional stress on the students to ensure they have selected the right program from the point of admission, and it adds challenges for those students who want to change programs.
2. Cohort based programs: while the cohort approach has benefits in terms of maintaining academic standards, it limits opportunities for transfer or bridge students (e.g., from colleges).

There was surprisingly little consideration for students who may want to join from another academic institution mid-program. These students can often be very qualified, and their external perspective can add value.

3. A lack of adherence to a CEAB prescribed and clearly defined Continuous Improvement Process: it was notable and troubling that groups in the faculty had been holding regular discussions on Learning Outcomes Assessments for over a decade, and yet no recent modifications of the curriculum that were based on the collection of Learning Outcome Assessments could be identified.

4. Indigenization and reconciliation: a great improvement has been made towards the gender imbalance issue in engineering, but there has been less progress in the area of Indigenization. This challenge is not unique to the University of Waterloo. As engineers, our primary duty of care is to the public good, but the question remains of how to best realize this in an Indigenous context. The program must help to promote the role of engineers and the practice of engineering in Indigenous communities, and the roles of Indigenous people in engineering. The initiatives such as “elder in residence” are welcome changes and demonstrate institutional commitment. Progress towards this goal should be maintained, while carefully ensuring that actions are substantive and not performative. There is risk that some of these actions could be counter-productive if they are not carefully vetted.

Program Response to External Reviewers’ Recommendations

1. One of the suggestions for improvement comes from the discussions with the teaching assistants (TAs). There was a consensus that some type of performance assessment of the TAs on a course-by-course basis, by the faculty members (or perhaps combined faculty and students) would be helpful. It would serve to both incentivize for the TAs to perform well, knowing that a formal evaluation will occur, and to alert them to any shortcomings in their performance where they could focus on improvement for their next assignment. It will simultaneously assist faculty members in their selection of TAs for future courses. There was also some concern that the time allocation of the TAs could be better organized. For example, before the start of semester, the TAs should be provided with a breakdown on how much time they might expect to allocate on specific tasks for the semester (e.g., 15 hours marking assignments, 15 office hours, 15 hours in tutorials, 4 hours preparation, etc.). Ideally this would be accompanied by some sort of timeline indicating in which weeks midterms are likely to occur, when are the major course deliverables to be submitted, so that they might be better able to schedule their workloads throughout the semester.

Program Response

Improving the process of evaluating TA performance has been an ongoing issue within the department. Until recently, TA evaluations were conducted by UG students at the end of every term. Under the direction of a class representative, the class would gather and grade each TA, and then return the grading to the UG Advisors. Unfortunately, class response rates have become lower with each successive term. In the terms leading up to the pandemic, fewer than half of the class cohorts would return the surveys, leaving a majority of TAs without any feedback. At the start of the pandemic, with no classes meeting in person, and with no direct contact between TAs and UG students, the evaluation process stopped entirely. Even pre-pandemic, TAs with little or no direct interaction with UG students were never properly assessed (e.g., exam or project markers, exam proctors). The evaluations of these TAs were either left blank or submitted with average ratings. As a final note, there has never been a process by which faculty supervisors could evaluate their own TAs. It was assumed that instructors would direct their TAs and provide feedback on their performance.

At this time, actions have already been taken to provide better feedback to TAs.

- The evaluation of TA performance by UG classes has been restarted. Class representatives have been briefed on the process, and an information campaign with the UG classes has been initiated to stress the importance of completing the surveys.
- A new TA evaluation process was initiated for instructors. At the end of each term, faculty are now being prompted to enter evaluations and TA feedback into an on-line system. Instructors have been introduced to the process via departmental mailout, and during a recent department meeting. This process has the added benefit of providing feedback to TAs who do not directly interact with UG students.

In recent years, MME has introduced a new on-line TA application process through which graduate students apply to, and compete for, specific TA positions. The purpose of the system was to make the TA selection process more equitable by preventing a first-come first-serve allocation of positions. Unfortunately, introduction of this process removed face-to-face interaction, where instructors presumably would communicate specific TA duties and expectations. Students are currently applying to TA for a specific course, with no foreknowledge of the particular course duties.

To correct this, the following actions have been taken.

- The on-line TA application process is being modified to include TA job descriptions. Graduate students will now be capable of applying specifically to marker or tutorial positions. This will also provide them with insight into the timing of the allotted duties, and the expected workload.
- Course instructors were spoken to during a recent department meeting about TA workload, and on their responsibilities to not only communicate with their TAs about job duties and TA performance, but also to not assign duties that exceed the expected workhours of the position.
- The department maintains an instructor handbook which provides information about everything from university teaching policy, to contact information, to advice on teaching pedagogy. The Teaching Assistant section of this document focusses on the number of TAs assigned, and on the things an instructor should not assign to a TA. It does not currently outline instructor obligations to TAs as their employer. This section of the document will be re-written to provide better guidance to instructors on this topic.
- The graduate office will be working with TAs to provide better feedback on their experiences, and to better inform them of their rights as TAs. This will first be done during the TA training course (ExpectATions) and reinforced in regular communication with all graduate students. By making TAs aware of their rights, and by providing them with a mechanism to report issues, it is expected that the department administration can more quickly intercede and better advocate on a TAs behalf.

Dean's Response

I support the department's approach related to performance assessment of TA's and communication to them about workload and duties as TA's.

2. There was also concern that an upgrade of the laboratories in the ME program is overdue, to ensure that the equipment is modern and well-functioning. This can be integrated as a part of the planned curriculum review.

Program Response

Over the past 20 years, laboratories primarily dedicated to the Mechatronics program have been created and updated. While these labs benefit the automation and control aspects of the ME curriculum, the fluids, thermal, materials and solid mechanics aspects of the program have continued to rely on old and outdated equipment. The Watimake facility is notable exception to the aforementioned investment. The Department has invested heavily in this

facility, and it is used extensively by both the ME and MTE programs. It is not, however, a student laboratory. Watimake should be viewed as a complement to the student machine shop that specializes in advanced rapid prototyping.

The issue of outdated student labs in the ME program is being addressed.

- In 2020, the department invested \$200k to support the creation of a shared use materials laboratory. The investment was largely dedicated to the purchase of new grinding and polishing equipment, and to renovate existing materials processing space. It also included the hire of a materials lab coordinator to oversee lab operation. In the past year, this facility has been expanded by the addition of a microscopy facility. Further expansion plans are underway, including the staff hire of a dedicated materials lab instructor.
- Space has been identified for a new UG thermo-fluids lab facility. The space is currently being prepared for renovation, and two faculty members have been assigned the task of identifying needed lab purchases and room layout. It is expected that the space can be completed by the spring term of 2023.
- Discussions are underway with the Student Design Centre and Student Machine Shop for the creation of new student welding facilities on campus. These facilities will support student teams, as well as the ME Welding Specialization which currently relies on off-campus facilities. New facilities should be in place for the fall term of 2023.
- Improvements to the solid mechanics labs are in the early planning stages.
- The MME Chair has dedicated \$200k per year towards faculty UG lab requests. This includes automatic matching of any funds successfully obtained from the Waterloo Engineering Endowment Fund (WEEF). For example, in the Winter term, Prof. Yue Hu received \$16k in funding from WEEF to replace programmable robots used in a 4th year ME/MTE robotics course. The Department added an additional \$16k.

Dean's Response

I support the department's proposed actions to address this recommendation.

3. The curriculum review should also address concerns related to work term preparation. One suggestion is to organize the calendar such that courses with practical job skills or training (e.g., programming languages, CAD and CAE tools, etc.) occur earlier in the program, to boost student attractiveness to potential employers. The curriculum review should include revisiting the list of specializations.

Program Response

In both the ME and MTE programs, several activities related to work term preparation already existed in the curriculum. For example:

- In ME100 and MTE100 (1A), time is spent specifically on things such as resume preparation, interview skills, professionalism and ethics in the workplace, and technical writing.
- The 1st Year Engineering Office dedicates several mandatory training sections, run by the co-op office (1A), that deal with resume and interview skills, job site expectations, and the resources provided by the co-op office.
- In the graphics portion ME100 and MTE100 (1A), students are introduced to common CAD software (chosen through employer surveys), and they are expressly advised to place this skill on their resume.
- Mechatronics students are introduced to programming skills in MTE121 (1A), and again in MTE140 (1B). Mechanical students get programming in ME101 (1B). Students are expressly advised to place these skills on their resume.
- The co-op office regularly offers voluntary workshops on workplace skills that range from resume building and interview skills, to networking and work search strategies. A full list of these workshops can be found at <https://uwaterloo.ca/career-action/workshops-and-events>.
- The Faculty of Engineering has long had the policy of hiring 1st and 2nd work placement students who were not placed late in the job placement process. In doing so, the faculty provides employment experience.
- The Faculty of Engineering has joined a program called (WE) Accelerate. The program offers 1st work term students an opportunity to build work skills on campus in place of a traditional work placement. The program launches in the Fall 2022 term. See <https://uwaterloo.ca/hire/waterloo-experience-accelerate> for more information.

Due to the shift to on-line learning, it is likely that the majority of students interviewed were unaware of the instruction provided. Better efforts will be made to emphasize and enforce these training options.

The curriculum review process had started prior to the pandemic shutdown. Now that UW has returned to in-person learning, the process has restarted, and is actively pursuing the creation of several options. Under consideration are specializations in building sciences / HVAC, aerodynamics, mechatronics, and forensics, as well as general streaming in the areas

of thermo-fluids, materials, and solid mechanics. Their plans were presented to the department in a recent department meeting. They are preparing a department retreat to discuss curriculum issues on April 25, 2023.

Dean's Response

I support the department's proposed actions to address this recommendation.

4. To combat the issue of academic integrity, the faculty should adopt a formal Faculty code of ethics and introduce in-program ceremonies or rituals akin to the Iron Ring ceremony where students are invited to publicly and regularly commit to the prescribed standard of behaviour. Experience has shown that these codes can be extremely effective when properly implemented, but this requires that the practice be fully endorsed by the faculty members.

Program Response

This point is strongly related to the on-line learning environment where Academic Integrity (AI) issues were a frustration to faculty and students alike. Data collected by the Associate Dean UG shows that the number of academic integrity cases brought forward over that period increased significantly. That same data shows the number of cases has dropped significantly since UWs return to in-person learning and assessment. As AI investigations are normally brought against less than 2% of engineering students, this is likely no longer an issue.

- Despite the reduction in AI cases, the Associate Dean UG has indicated that he would raise the issue of a code of ethics during the next Faculty Operations (FOPS) meeting. The discussion will include all Associate Chairs UG and Program Directors in Engineering, as well as senior administration from the 1st year engineering office.
- Instructors are to be reminded that they are required to include an AI statement in their course syllabi. The reminder will be in an upcoming Department Meeting, and clarification will be added to the MME teaching guidelines.
- The department made a curriculum change during a recent department meeting aimed at increasing ethics education in the UG program. A proposal was passed unanimously that requires all students to take an ethics-based course, either as one of their CSEs (PHIL315 Ethics and the Engineering Profession), or as part of their WatPD requirements (PD21 Professionalism and Ethics in Engineering Practice).

The University of Waterloo does have an Office of Academic Integrity (OAI), who works with both students and faculty to promote and communicate integrity issues across the campus (<https://uwaterloo.ca/academic-integrity/about-office-academic-integrity>). The OAI offers Academic Integrity training to both UG and Graduate students during orientation and in class through workshops and presentations. They also offer on-line integrity training modules.

- MME will investigate increasing OAI involvement in the ME and MTE programs going forward.

Dean's Response

In addition, I have asked my Associate Dean Teaching and Student Experience to look into the development of an “iron pin” ceremony similar to what UBC, MUN and Guelph have implemented for 1st year engineering students as they start their academic journey towards becoming an engineer. This will be used as a way to stress the expected code of conduct for Waterloo Engineering students. I anticipate this will be in place during 2023.

5. The Faculty should recommit to a Continuous Improvement Process as identified by the CEAB, wherein the class achievement of the course Learning Outcomes is assessed, and this assessment metric data is used to inform changes to the curriculum. The process itself should be clearly defined, e.g., reporting processes and delivery schedule of assessments, etc.

Program Response

During preparation of ME/MTE Accreditation visit in 2019, this issue was recognized by the Associate Chair UG. At that time, the Department UG Studies Committee (UGSC) dealt with all aspects of the UG program including: scheduling, UG policy, student grievances, curriculum, etc. A new committee was formed, the Curriculum Review Committee (CRC), which would deal with curriculum improvement. The UGSC would continue, but only deal with issues related to the operation of the UG program.

The CRC was formed in 2019. It currently comprises teaching track faculty and is led by the Graduate Attributes Lecturer (Prof. Andrew Milne). As the Graduate Attributes Lecturer, Prof. Milne is responsible for surveying both faculty and staff on issues related to the undergraduate program, for identifying and monitoring program metrics, and for the keeping of records related to program Learning Outcomes.

The activities of the CRC were slowed significantly by the pandemic. They have now resumed activities and are in the process of collecting information from program stakeholders. To date, the CRC:

- Has met with MMEs newly formed industrial review panel to obtain industry feedback on the existing program.
- Has surveyed and met with most faculty to determine program deficiencies and strengths, along with areas for improvement.
- Has surveyed both current and graduated students for their impressions of the program. The results of these consultations were presented over several department meetings, most recently on 7/27/2022. To complement these efforts, a department curriculum retreat is being planned for April 25, 2023.

Dean's Response

I support the department's proposed actions to address this recommendation.

6. The Faculty should continue the efforts on addressing gender equity and diversity, and Indigenous issues.

Program Response

Addressing issues of equity, diversity, and inclusivity is of paramount importance to the Department, Faculty, and University. In 2021, the Dean of Engineering appointed Prof Mary Robinson to be the 1st Associate Dean, Outreach, Equity, and Diversity. In that role, and with full support of the Engineering Departments, Prof. Robinson has put forward several EDI initiatives, and facilitated Engineering's participation in several existing initiatives. These include:

- The creation of a new EDI Website
- Participation in the PALs program to promote EDI-R training across the campus
- The creation of the Equity Champion role within the engineering community
- Continued involvement in WiE
- Activities that draw attention to gender-based violence
- Work to improve washroom accessibility on campus, and to provide free menstrual products
- Participation in the IBET PhD Project which provided scholarships and mentoring to black and indigenous students
- Creation of the Elder in Residence and Indigenous spaces within the Engineering Faculty.

The contributions of the Associate Dean, Outreach, Equity, and Diversity are numerous. Appended to this report is a more thorough accounting of activities and initiatives of that office ([Appendix A](#)).

In addition to the role of the Dean's Office, the University continues to work towards a more inclusive environment. Through the Office of Equity, Diversity, Inclusion & Anti-Racism, and the Office of Indigenous Relations numerous initiatives are both actively engaged in the creation of a workplace that is welcoming to all students, faculty, and staff.

Dean's Response

In addition to what the department has outlined we have undertaken, we have also embarked on training for faculty and staff related to what an inclusive workplace looks like for employees and students and this is being implemented over the next year.

7. Explore opportunities for the creation of pathways for transfer students from other institutions, or promotion of opportunities to study abroad. This will require careful attention to the curriculum, or perhaps require an extension of the time in program, but could add valuable outside perspective to the student body.

Program Response

Student transfers from other institutions to MME have always been difficult. Transfer requests go to university admissions where the application package is first assessed. As transfer students are required to meet UW entrance averages (which are high), many applications do make it past this point. The number of transfer requests forwarded to the department each year is on the order of 4 or 5. The department does its best to consider these requests, and does allow 1 or 2 transfers per year. Unfortunately, there is little space in existing cohorts due to low attrition rates, and incoming students cannot usually meet mandatory coop requirements for the program. MME is not in a position to address either of these roadblocks.

With respect to student exchange, the faculty operates an active exchange program in 3A and/or 3B for any student wishing to study abroad.

- The department regularly allows students to pre-clear courses, stream switch within the program, or to take courses while on co-op. On doing so, we accommodate the study term with minimal impacting the student progression.

- The department has appointed exchange coordinators for both the ME and MTE programs. These coordinators review course offerings, provide advice during the planning phase, and monitor students while they are away.
- There are other resources in the Dean's office which connect students to other institutions. (<https://uwaterloo.ca/engineering/undergraduate-students/international-exchange>). These options are presented to students at the start of every term, with instructions on planning for exchange.
- At the university level, there are programs for International Studies Option / Global Experience Certificate, and an option for International Work Terms

As can be seen, there are significant opportunities and support for studying and working abroad. Prior to the pandemic shutdown, between 10 and 15 ME students would be studying abroad at any given time. The uptake in MTE transfers was lower, but only because there are fewer such programs worldwide, and therefore less opportunity for these students to travel. It is likely that this concern came from students who were unable to take part in this program due to COVID travel restrictions, and who are unaware of supports in this area. MME will be sure to reinvigorate interest in the program and bring it back to students' attention in the coming terms.

Dean's Response

As a member of Engineering Deans Canada, I am also actively working with the Canadian Engineering Accreditation Board (CEAB) to find pathways to make international exchanges easier and the number of students who engage in them can be expanded.

Recommendations Not Selected for Implementation

It is noted that while all of the recommendations are helpful, several seem to have their origins in the pandemic shutdown. Travel restrictions prevented exchange programs and resulted in the cancellation of many co-op job opportunities. The switch to on-line learning presented special challenges in maintaining the quality of learning and integrity of the examination process. There is evidence that some of the issues that were identified may be rectifying themselves now that in-person education has resumed. Still, the recommendations serve as a great reminder of the programs, policies and procedures that we once had. They not only emphasize the importance of bringing them back, but also show us that we need to invest in making them more resilient.

These include:

- Recommendation 3 regarding Work Term Preparation. The faculty is actually quite focused on providing new students with relevant work placement experience. Unfortunately, many of these activities were in person, and many of the work placements were on-line. At this time, student training has resumed. The comment, however, is a great reminder of the importance of preparing students to succeed in the workplace.
- Recommendation 4 regarding Academic Integrity. The switch to on-line learning coincided with a significant increase in AI allegations within the Faculty. This was concerning to students and faculty alike. Now that in-person learning has resumed, the number of AI allegations has dropped significantly. Existing safeguards may well be sufficient at this time. Still, efforts to improve the AI within the student body should be continuous.
- Recommendation 7 on student exchanges. The department, faculty, and university invest significant resources toward promoting and facilitating student exchanges. These opportunities were cancelled due to pandemic travel restrictions, and therefore, no student currently in the program has ever had the opportunity to take part in an exchange. At this time, the programs have resumed, and the Department is increasing efforts to re-advertise study abroad opportunities to students.
- Recommendation 7 on student transfers. The Department is open to student transfers. Unfortunately, to qualify for a transfer, applying students must meet UW admission standards and be capable of meeting co-op requirements for graduation. There must also be space in the class that they'll be joining. While transfers are considered (and sometimes successful), they are difficult to facilitate.

Implementation Plan

| | Recommendations | Proposed Actions | Responsibility for Leading and Resourcing (if applicable) the Actions | Timeline for addressing Recommendations |
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| 1. | Some type of performance assessment of the TAs on a course-by-course basis, by the faculty members (or perhaps combined faculty and students) would be helpful | <p>Recommencement of the term-end student evaluation process starting Winter 2022.</p> <p>New on-line TA evaluation process for course instructors. To be tested in Winter 2022 with full implementation by Spring 2022.</p> <p>Modification of on-line TA application process to include TA job descriptions. To be tested in Spring 2022 for Fall 2022 TA positions with full implementation for the Winter 2023 term.</p> <p>Meeting with course instructors to reiterate instructor obligations as a TA employer.</p> <p>Updates to instructor manual, and associated instructor resource material.</p> <p>Improved communication of TA rights to graduate students during TA training. Starting with Fall term TA training.</p> | <p>MME, Undergraduate Office</p> <p>MME, Undergraduate Office and IT support</p> <p>MME, Graduate Office and IT support</p> <p>MME, Department Chair</p> <p>MME, Undergraduate Office</p> <p>MME, Graduate Office</p> | <p>Completed</p> <p>Completed</p> <p>In progress. System is being tested. Full implementation for W2023.</p> <p>Completed. Dept. Meeting on 7/27/22.</p> <p>In progress. To be completed by 12/31/22.</p> <p>Next offering in Fall 2022, and all future offerings.</p> |

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| 2. | <p>Upgrade of the laboratories in the ME program is overdue, to ensure that the equipment is modern and well functioning. This can be integrated as a part of the planned curriculum review.</p> | <p>Creation of shared use materials lab. Material preparation and microscopy areas are complete, and a dedicated lab coordinator has been hired. Further expansion will be made to this facility.</p> <p>Hire of new Materials lab instructor. Job posting in preparation for end of Spring term.</p> <p>Creation of new Thermo-Fluids lab facility. Room is being prepared for renovation.</p> <p>Creation of new welding facilities in support of Welding Specialization</p> <p>Renovation of Solids lab facilities.</p> <p>Investment of Department in UG lab facilities. \$200k per year with matching to secured WEEF funding.</p> | <p>MME, Space Committee</p> <p>MME</p> <p>MME, Space Committee</p> <p>MME, Space Committee</p> <p>MME, Space Committee</p> <p>MME, Space Committee</p> <p>MME, Department Chair</p> | <p>Initial steps completed. Ongoing improvements.</p> <p>Anton Gorny Hired March 1, 2023</p> <p>In progress. Expected completion 8/31/23.</p> <p>In progress. To be completed by 8/31/23.</p> <p>Not yet started.</p> <p>In progress and ongoing.</p> |
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| 3. | <p>The curriculum review should also address concerns related to work term preparation. The curriculum review should include revisiting the list of specializations.</p> | <p>Several initiatives are in place to support success during coop terms. Better effort will be made to remind UG students of the supports that are available to them.</p> <p>The Curriculum Review Committee had stalled during the shutdown and has now resumed their efforts. Plans for curriculum review, including the creation of several new specializations, were presented to the Department. A curriculum retreat is being planned for the Fall term.</p> | <p>MME, 1st Year Instructors FOE: 1st Year Engineering</p> <p>MME, Curriculum Review Committee</p> | <p>In progress and ongoing.</p> <p>Completed. Dept. Meeting on 7/27/22.</p> <p>Completed. April 25, 2023.</p> |
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| 4. | <p>The faculty should adopt a formal Faculty code of ethics and introduce in-program ceremonies or rituals akin to the Iron Ring ceremony where students are invited to publicly and regularly commit to the prescribed standard of behaviour. This requires that the practice be fully endorsed by the faculty members.</p> | <p>The Associate Dean Undergraduate will be introducing the concept of a code of ethics for students at the next Faculty Operations Meeting (FOPS).</p> <p>Reminder to faculty of mandatory ethics statement in course syllabi.</p> <p>Updates to instructor manual, and associated instructor resource material.</p> <p>An ethics course requirement has been made mandatory in the undergraduate program. Students are now required to take PHIL315 or PD22.</p> <p>The Department will work with the Office of Academic Integrity to offer ethics seminars to both students and faculty, and to better introduce ethical standards to 1st year classes.</p> | <p>FOE, Associate Dean Undergraduate</p> <p>MME, Department Chair</p> <p>MME, Undergraduate Office</p> <p>MME, Undergraduate Office</p> <p>MME, Undergraduate Office</p> <p>MME, 1st Year Instructors</p> | <p>Iron Pin Ceremony will be first conducted with in Sept 2023.</p> <p>Meeting on 7/27/22.</p> <p>In progress. To be completed by 12/31/22.</p> <p>Completed. Dept. Meeting on 2/23/22.</p> <p>1st ethics lectures in preparation for Fall 2022.</p> |
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| 5. | The Faculty should recommit to a Continuous Improvement Process as identified by the CEAB, wherein the class achievement of the course Learning Outcomes is assessed, and this assessment metric data is used to inform changes to the curriculum | <p>A Curriculum Review Committee (CRC) has been formed consisting of teaching track faculty and chaired by the departments' outcome-based assessment coordinator (Prof Andrew Milne).</p> <p>Stakeholder interviews have been conducted with students, faculty, and the Departments' industry review panel. Results were presented to the Department on 7/27/2022.</p> <p>A curriculum retreat is being planned for the Fall term.</p> | <p>MME, Undergraduate Office</p> <p>MME, Curriculum Review Committee</p> <p>MME, Curriculum Review Committee</p> | <p>Completed. Fall 2019</p> <p>Completed. Fall 2021 to Spring 2022</p> <p>Completed, April 25, 2023.</p> |
| 6. | The Faculty should continue the efforts on addressing gender equity and diversity, and Indigenous issues. | Please see attached list of Faculty Level initiatives. | FOE, Associate Dean of Outreach, Equity, and Diversity | Several Ongoing Initiatives |
| 7. | Explore opportunities for the creation of pathways for transfer students from other institutions, or promotion of opportunities to study abroad. | The ability to study and work abroad is heavily supported by MME, the FOE, and the University. Each year, between 15 and 20 students in MME study at other institutions. This process was shut down due to international travel restrictions. It has now restarted. | MME, Undergraduate Office | International study restarted in Winter 2022 |

The Department Chair/Director, in consultation with the Dean of the Faculty shall be responsible for the Implementation Plan.

Date of next program review _____ **2027-2028**
Date

Signatures of Approval




Chair/Director

Aug 29, 2023

Date

AFIW Administrative Dean/Head (*For AFIW programs only*)

Date



Faculty Dean

August 30, 2023

Date

Note: AFIW programs fall under the Faculty of ARTS; however, the Dean does not have fiscal control nor authority over staffing and administration of the program.



Associate Vice-President, Academic
(For undergraduate and augmented programs)

July 24, 2023

Date

In General:

| What we're doing | Status |
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| <p>Engineering EDI (Equity, Diversity & Inclusion) Website (https://uwaterloo.ca/engineering-equity-diversity/)</p> <ul style="list-style-type: none"> • A hub for EDI events, trainings and information for faculty, staff, and students • Amplifying great activities and events going on around campus and the community in addition to those offered specifically in Engineering. | <p>Launched: February 2022 Regularly updated with new information</p> |
| <p>EDI-R PALS</p> <ul style="list-style-type: none"> • EDI-R = AVP Equity, Diversity, Inclusion & Anti-Racism at the University-level • PAL = Program Area Leads (https://uwaterloo.ca/human-rights-equity-inclusion/equity-office/program-area-leads-pals#) <p>Mary Robinson was selected as the PAL for the faculty of Engineering in June 2022.</p> | <p>Launched: June 2022 Monthly meetings & training session as PALS program rolls out across campus</p> |
| <p>EngSoc Inclusivity Commissioner</p> <ul style="list-style-type: none"> • Undergraduate student position, selected by the Engineering Society, to liaise with the AD Outreach, Equity and Diversity and EngSoc affiliates (NSBE, AISES, WiE, EngiQueers,) on matters relating to EDI | <p>Launched: 2020 Regular contact between AD portfolio and undergraduate students, including micro-grants to support initiatives started by students for students such as attending Toronto Pride (June 2022)</p> |
| <p>Equity Champions</p> <ul style="list-style-type: none"> • A collection of faculty & staff in the departments and schools across the faculty of Engineering, working collaboratively to address of equity, diversity and inclusion. • Review existing Engineering policies and processes with an equity lens • Recommend/arrange training opportunities as needed in their particular department/school • First area of focus is around reviewing equitable hiring practices across Engineering | <p>Under development. Current plan is to open applications in Fall 2022; candidates self-nominate with ok from director/chair</p> |

Appendix A
Gender Equity & Diversity:

| What we're doing | Status |
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| <p>Women in Engineering (WiE) committee</p> <ul style="list-style-type: none"> • WiE brings together faculty, staff and students to address the needs of women-identifying folks in Engineering • Both the undergraduate and graduate students have their own free-standing committees • Activities for peer-to-peer support, advocacy, outreach, recruitment and education throughout the year • Supported by an outreach coordinator | <p>Ongoing since 1992. Faculty-wide committee meets nine times/year.</p> |
| <p>Gender-Based Violence Education</p> <ul style="list-style-type: none"> • In partnership with SVPRO (Sexual Violence Prevention & Response Office) and community partners <p>16 Days of Activism Against Gender-Based Violence (General Audience)</p> <ul style="list-style-type: none"> • a collection of self-directed, remote, and in-person activities to help educate the Engineering community around gender-based violence, the role of male allies, and bystander intervention <p>Undergraduate Students</p> <ul style="list-style-type: none"> • Mechanical & Mechatronics Engineering students in 1B academic term – 2-hour session includes viewing of Picture a Scientist with structured discussion around roles as male allies and bystanders • Electrical & Computer Engineering students in 1A & 1B academic terms, approx. 3 hours/term, modules and workshops around understanding gender-based violence and role as male allies and/or bystanders to interrupt this violence. <p>Graduate Students</p> <ul style="list-style-type: none"> • Learn-based module under development by Centre for Teaching Excellence for responding to disclosures of sexual violence training for TA <p>Faculty, Staff & Research Group</p> | <p>Nov-Dec 2021 (to be repeated annually) (https://uwaterloo.ca/engineering-outreach/16-days-activism-against-gender-based-violence-engineering)</p> <p>Launched July 2021 with ME, expanded to MTE in March 2022 In partnership with SVPRO On-going with regular refinement</p> <p>Launched Sept 2020 1A modules in Fall 2020, 1B modules in Winter 2022, in partnership with SVPRO On-going with regular refinement, lead by ECE Wellness Coordinator</p> <p>Learn module complete. Planning pilot roll-out underway</p> |

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| <ul style="list-style-type: none"> Helping those in positions of power understand their responsibilities and power/privilege, beyond sexual harassment training | <p>Pilot launching July & into Fall 2022 with couple of groups</p> |
| <p>Washroom Accessibility</p> <ul style="list-style-type: none"> Completed an in-person review of all washrooms in Engineering buildings Identify where discrepancies exist (e.g. no women's washroom on a floor) and recommend solutions Includes physical accessibility, access to change tables, and ungendered washrooms | <p>Survey completed June 2022 Updated list of washrooms published on EDI website, shared with EngSoc and centrally.</p> |
| <p>Menstrual Equity</p> <ul style="list-style-type: none"> No menstrual supplies currently provided in washrooms across campus; those that do exist being done <i>ad hoc</i> by folks in those buildings. Plans to stock menstrual products in vending machines have not materialized | <ul style="list-style-type: none"> June 2022 – posters at washrooms in E5, E6 & E7. Centralized free menstrual product supply pick-ups in E7 and CPH July 2022 – posters being added to washrooms in RCH, DWE, E2, E3 and CPH Identifying more centralized pick-up locations across campus until in-washroom solution developed On-going conversations at university-level around developing a centralized solutions |
| <p>On-going support of cross-campus initiatives</p> <p>Truth Values Play + Panel</p> <ul style="list-style-type: none"> In partnership with Women in Math (WiM) and Women in CS (WiCS), hosting the one-woman play <i>Truth Values</i> and follow-up panel discussion <p>Engendering Success in STEM (ESS) Consortium (https://successinstem.ca/)</p> <ul style="list-style-type: none"> PRISM research groups in ESQ summer camps around boys & girls' attitudes towards STEM proficiency RISE to interrupt biases in faculty members | <p>Sept 2022</p> <p>Summer 2019 & 2020</p> <p>Summer 2021 & present</p> |

Indigenous Issues

| What we're doing | Status |
|---|---|
| <p>IBET PhD Project (IBET = Indigenous and Black Engineering and Technology Momentum Fellowship - https://uwaterloo.ca/engineering/indigenous-and-black-engineering-and-technology-momentum)</p> <ul style="list-style-type: none"> Created at UWaterloo in 2020 \$30,000/year fellowship paid by one of 15 partner institutions + mentorship + community with peers studying in Engineering and Computer Science Targeted intervention to address chronic under-representation of Black and Indigenous folks in STEM fields by providing culturally-relevant supports. | <p>Launched January 2021</p> <ul style="list-style-type: none"> 2021 cohort: 17 fellows (1 Indigenous) 2022 cohort: 11 fellows (2 Indigenous) |
| <p>Engineering Elder-in-Residence</p> <ul style="list-style-type: none"> Hiring Bill Woodworth (<i>Rawe:nokwas</i>) who is Mohawk, Bear Clan, of the Haudenosaunee of the Six Nations. (https://uwaterloo.ca/engineering/about/people/wwoodwor) | <p>Sept 2021 (1-year), extended for 5-years to 2027.</p> |
| <p>Indigenous Spaces in Engineering</p> <ul style="list-style-type: none"> Elder's Office on both Waterloo (Engineering) and Cambridge (Architecture) campuses where folks can meet with the Elder-in-Residence in a culturally-appropriate space Elder's Garden – traditional plants growing on the Engineering campus (wild strawberries, tobacco) Physical land acknowledgements in all Engineering buildings, incorporating traditional signage such as bent trees. | <p>July 2022: dedicated spaces in both locations, renovations underway</p> <p>June 2022-present</p> <p>Securing funding, identifying artists + locations. Installation to begin 2023.</p> |
| <p>Indigenous Learning Opportunities</p> <ul style="list-style-type: none"> KAIROS Blanket Exercises for faculty (https://www.kairosblanketexercise.org/) At the Woods' Edge - Tsi Khaharkta (GenE499, Arch 285) – a retelling of the history of settler-Indigenous relations from first contact to today, by Elder Bill June 21 Indigenous Peoples' Day Celebrations – Haudenosaunee Thanksgiving Address to start the day, Indigenous feast at lunch, teachings by Elder Bill [Working title – Interacting with Indigenous Elders] – course under development by Leslie Wexler (https://uwaterloo.ca/centre-for-teaching-excellence/people-profiles/leslie-wexler) to help folks in Engineering understand protocol for working with Elders and Knowledge Keepers | <p>3 offered Oct 2020 – June 2021</p> <p>May-Aug 2022 (offered again Spring 2023?)</p> <p>June 21 2022</p> <p>Planned for Fall 2022.</p> |

Outreach Coordinator (Indigenous)

- Hire a local, Indigenous person to lead outreach activities to Indigenous communities and support activities in Engineering

To be posted Fall 2022

Job description under review with Office of Indigenous Relations