FINAL ASSESSMENT REPORT

Institutional Quality Assurance Program (IQAP) Review

MECHANICAL ENGINEERING (UG) PROGRAM

Date of Review: March 28 – 29, 2023

In accordance with the University Institutional Quality Assurance Process (IQAP), this final assessment report provides a synthesis of the external evaluation and the internal response, and assessments of the undergraduate program delivered by the Mechanical Engineering program. This report identifies the significant strengths of the program, together with opportunities for program improvement and enhancement, and it sets out and prioritizes the recommendations that have been selected for implementation.

The report includes an Implementation Plan that identifies who will be responsible for approving the recommendations set out in the Final Assessment Report; who will be responsible for providing any resources entailed by those recommendations; any changes in organization, policy or governance that will be necessary to meet the recommendations and who will be responsible for acting on those recommendations; and timelines for acting on and monitoring the implementation of those recommendations.

Executive Summary of the Review

In accordance with the Institutional Quality Assurance Process (IQAP), the Faculty of Engineering submitted a self-study in February 2023 to the Vice-Provost (Teaching and Learning) to initiate the cyclical program review of the Mechanical Engineering undergraduate program. The approved self-study presented program descriptions, learning outcomes, and analyses of data provided by the Office of Institutional Research and Analysis.

Two arm's length external reviewers and one internal reviewer were endorsed by the Dean, Faculty of Engineering and selected by the Vice-Provost (Teaching and Learning). The review team reviewed the self-study documentation and then conducted a virtual site visit on March 28 – 29, 2023. The visit included interviews with the Vice-Provost (Teaching and Learning), Deputy Provost, Dean of the Faculty of Engineering, Chair of the Department, Acting Associate Dean (Academic), and meetings with groups of current students, full-time faculty, and support staff.

The Dean of the Faculty of Engineering, and Chair of the Department submitted responses to the Reviewers' Report. The initial response was prepared by the program in June 2023, and finalized by the Dean in March 2024. Specific recommendations were discussed, and clarifications and corrections were presented. Follow-up actions and timelines were included.

- **Strengths**
  - The department has consistently demonstrated strong leadership in the enhancement of diversity within the Faculty of Engineering. Through the implementation of a unique faculty hiring program designed to enhance gender diversity, there has been a significant increase in the number of female faculty members in mechanical engineering.
  - Additionally, there has been a notable increase in gender diversity among the student population. The percentage of female undergraduate mechanical engineering students has risen from 13% in 2016 to 32% in 2022, exceeding the Ontario target of 30% by 2030. The emphasis on Equity, Diversity, and Inclusion (EDI) is embedded within each year of the undergraduate mechanical engineering curriculum, ensuring that all students are exposed to these important values.
  - The program outcomes are well-defined and are aligned with the Canadian Engineering Accreditation Board (CEAB) graduate attribute and continual improvement process. This ensures that students graduate with the necessary skills and knowledge to succeed in their chosen fields.
  - The department offers a large number of technical electives, allowing students to specialize in one of three areas: manufacturing, mechanics and design, or thermofluids and energy systems. In Fall 2023, the department plans to add a specialization in "Smart Systems" and has already hired three new faculty members to support this new area of focus.
  - The program also benefits from exceptional laboratories, computing facilities, and project spaces that provide students with the resources they need to excel in their studies. The "composite laboratory" model has proven to be very effective, as it is well-organized and has received positive feedback from students. The recent shift towards less prescriptive and more open-ended laboratory experiments is also seen as a positive development.
  - The self-study report states that a very high percentage of students (i.e., 93%) chose to complete a co-op placement in 2022/23, providing students with important career development and workplace skills that complement their undergraduate program.
  - Overall, the program's strengths lie in its commitment to diversity, well-defined outcomes, variety of elective options, excellent facilities, and co-op work placements, all of which contribute to a positive learning experience for students.

- **Opportunities for Improvement and Enhancement, including appropriateness of resources.**
  - The student enrollment in the program has seen a significant increase, rising from 473 in 2015 to 727 in 2022. This growth has led to the hiring of 10 new faculty members since 2015, with five of them joining in 2022/2023. However, this expansion has put pressure on the department's space, leading to a shortage of professor office space and research labs.
  - Despite the department's commendable efforts to increase gender diversity, there is still a need for more women faculty members and women graduate students. This will further enhance the program's diversity and promote a more inclusive learning environment. Similarly, the undergraduate students reported that equity, diversity, and inclusion (EDI) content has been embedded into some courses, which is a welcome change. However, there is room for improvement. Students reported that the week of EDI lectures in the first-year PIVOT course are not well attended, and the content is not properly assessed. Although introduced to students, best EDI practices for group work in upper-year courses are not consistently implemented: e.g., addressing historical bias of assigned roles, equitable opportunities for all to contribute.
  - The consistent provision of academic accommodations by course instructors was also identified as an area in need of attention. Students feel they are well supported by Student Accessibility Services (SAS). However, some instructors did not provide required accommodations for in-class tests, and in some cases, accommodated students were notified on the morning of a midterm that they would be writing at a later date and/or time.
  - It was noted by both students and instructors that the 2nd-year courses on measurement and integrated design would benefit from an update to include more mechatronics content and methodology, e.g., various types of sensors, filtering of noisy data, coding with Python and/or Matlab, etc. Such a change would also support the new program stream in Smart Systems.
  - Additionally, there is a need for more support staff, particularly in the office, to meet peak needs. One suggestion would be to hire someone at the Faculty level who could help address this issue and ensure that the department runs smoothly and efficiently.

Summary of the Reviewers' Recommendations with the Program's and Dean's Responses

Recommendation #1: **Need for more support staff.**
Department's Response and Actions to be Taken: Agreed. Over the past ten years there has been tremendous growth in the number of students and an increase in the number of faculty members in Mechanical without a proportional increase in staffing. We recommend hiring an additional staff member to support both graduate and undergraduate administrative positions, providing assistance as needed. Funding from the University is required for this hire.
Dean's Response: There is a plan to create a role for an undergraduate administrative assistant to be shared between Mechanical Engineering and another department. However, the post-secondary sector in Canada is experiencing a financial crisis, and so this plan is on hold at this time.
Recommendation #2: **Improved coordination across programs.**
Department's Response and Actions to be Taken: Agreed. A lack of coordination has led to problems with course timetabling. We would request that the Faculty of Engineering put processes in place (and provide sufficient staffing) to address this issue.
Dean's Response: It is true that timetabling processes have historically been cumbersome, particularly where permissions and overloads were concerned. The Academic Advising Office was a bottleneck for these processes due to permissions required to resolve these issues. However, through collaboration with the Registrar's Office over the past year, we have successfully rerouted these timetabling activities to the departments. This adjustment has significantly expedited service for students. With the removal of this bottleneck, feedback indicates satisfaction among students, departments, and academic advisors with the streamlined process.

Recommendation #3: **Implementation of EDI principles into group work settings**
Department's Response and Actions to be Taken: We have previously provided instructors with best practices for group work. We will include this as an agenda item at a department meeting in early Fall. Dr. Kim Jones, who has expertise in this area, will be invited to speak to the Department. MacPherson is also able to provide 1:1 resources with instructors.
Dean's Response: Dr. Kim Jones is the Chair of the Ontario Network for Women in Engineering, and a Professor in Chemical Engineering. She conducts research in the area of EDI in group work, and will be well aware of the most current, and best, practices. Inviting Kim to a department meeting is the best way to reach most faculty members. The Equity and Inclusion Office (EIO) is also available to work with the department on matters of equity and inclusion in the classroom. MacPherson Institute (MI) is also an excellent resource and I encourage all faculty members to make use of their expertise. It is worth noting, however, that support from MI must be sought out by instructors, and only those with a particular interest will approach them.
Recommendation #4: **Better awareness of and implementation of SAS accommodations**
Department's Response and Actions to be Taken: Agreed. Instructors in Mechanical Engineering would benefit from training on the implementation of student accessibility accommodations. We will invite an advisor from SAS to speak at a fall department meeting to ensure that instructors fully understand the breadth of student accessibility issues. MacPherson could also provide support on this through their accessibility and inclusion education developers.
Dean's Response: I fully agree with the Department's approach. In addition to this, it has been suggested that integrating certain principles of Universal Design for Learning (UDL) can build many of the more common SAS accommodations directly into a course. To evaluate the impact of UDL on student experience and the associated instructor burden, the Associate Dean Undergraduate is launching a pilot project during the summer of 2024. This project aims to integrate UDL principles into an existing course through personalized meetings with an educational developer and the establishment of a community of practice among faculty members who are implementing UDL principles in their courses. The impact of these principles will be

evaluated during the next course offering. I strongly encourage Mechanical Engineering to participate in this project to test these hypotheses. However, it should be emphasized that while UDL may help mitigate the need for some accommodations, it will not eliminate the necessity for SAS accommodations or MSAFs due to the diverse needs of learners. The primary goal of implementing UDL is to ensure that course materials and assessments are accessible across the spectrum of student diversity, enabling them to showcase their best work.
Recommendation #5: **Update 2nd year measurements course**
Department's Response and Actions to be Taken: Agreed. This will be a focus over the 2022/23 academic year and will be a strategic goal of the lab committee and the MECHENG 2B03/2BA3 instructors. We will also work with the Engineering specialist from the MacPherson Institute in the development of revised learning outcomes and implementation of experiential learning.
Dean's Response: I am happy with the Department's approach to updating this course. It is worth noting that the Graduate Attributes Continuous Improvement process ensures that each accredited program is updated and improved on continuous basis.

McMaster University

Implementation Plan

In the chart below, please outline the recommendations made by reviewers, briefly outline the actions you plan to take, who will be responsible for leading the action, and a timeline for completion.

Recommendation	**Action(s) to be Taken**	**Responsibility for Leading Action** (specify the role(s) that will be responsible for each action item e.g. Program Chair.)	**Timeline for Completing Action** (indicate specific timelines (e.g. not 'ongoing') for action)
Need for more support staff	**Funding for a new staff position in Mechanical Engineering would need to be approved at the Faculty of Engineering level.** **Departmental Actions:** - **Chair to work with Department Administrator to develop job description for new position.** - **Post position and hire staff member.**	- **Dean of Engineering to approve funding** - **Department Chair and Administrator**	- **December 2023**
Improved coordination across programs	**Faculty of Engineering could put processes in place and provide sufficient staffing to improve coordination and communication between programs.**	- **Associate Dean (Academic)**	- **End of 2023/24**

Implementation of EDI principles into group work	**Invite Kim Jones to speak at an early fall department meeting on best practices on EDI in group work.** **Connect instructors with MacPherson resources for 1 on 1 support.**	- **Department Chair**	- **Early fall 2023**
SAS coordination	**Invite SAS advisor to speak at an early fall department meeting.** **MacPherson can also provide support on accessibility.**	- **Department Chair**	- **Early fall 2023**
2nd year measurements course	**Develop new learning outcomes and experiential learning strategies focusing on greater incorporation of mechatronics content.**	- **Department Chair to work with Dept Lab committee and current instructor of 2B03/2BA3 to revamp course and labs. Invite Engineering specialist from MacPherson for guidance on developing new learning outcomes and implementation of experiential learning.**	- **Plan should be developed by end of 2023/24.** - **New labs would need to be phased in according to a longer-term plan.**

Quality Assurance Committee Recommendation:

McMaster's Quality Assurance Committee (QAC) reviewed the above documentation at the June 2024, meeting. The committee recommends that the **Mechanical Engineering** program should follow the regular course of action with an 18-month progress report and subsequent full external cyclical review to be conducted no later than eight years after the start of the last review.