FINAL ASSESSMENT REPORT

Institutional Quality Assurance Program (IQAP) Review

MATERIALS 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 Materials 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 Materials 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, Director of Engineering & Society and Engineering & Management programs, and 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 October 2023, and finalized by the Dean in April 2024. Specific recommendations were discussed, and clarifications and corrections were presented. Follow-up actions and timelines were included.

Strengths

1. Student enrolment is healthy compared to MSE programs in North America. The program has consistently attracted a diverse and gender-balanced cohort over the past few years, with a focus on increasing underrepresented minority representation. One notable achievement is the substantial increase in the percentage of female students, rising from 25% in 2016 to 49% in 2022, surpassing the Faculty average.
2. A significant addition to the program is the Integrated Biomedical Engineering and Health Sciences (IBEHS) program, allowing students to explore different degree paths thus contributing to the program's overall growth.
3. The program emphasizes community engagement by requiring students to complete capstone projects sponsored by local industries and encouraging faculty and students to participate in outreach activities promoting STEM education within the community.
4. The curriculum reflects the current state of materials science and engineering, offering a wide range of core and elective courses, including options for management and society specializations. Recent innovations in program delivery aim to improve the learning experience, with a focus on experiential learning in Year 2.
5. The program boasts well-equipped laboratories, though some equipment requires replacement. Plans for laboratory renovations are in progress, which could enhance hands-on training.

Opportunities for Improvement and Enhancement, Including Appropriateness of Resources

1. The program has undergone a recent diversification of the curriculum to cover a broader range of materials, including biomaterials. However, students felt these changes were not well represented in teaching labs and co-op opportunities. Enhancements to teaching labs and co-op opportunities to continue this work of program diversification is recommended
2. Students identified a heavy workload as a difficulty they faced throughout the program. Taking the time, with the help of an administrator, to better schedule activities (e.g. mid-terms, project deadlines, etc.) across courses within a given year or cohort is recommended to improve the student experience.

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

Recommendation #1: Recent changes to the first-year curriculum compromised materials science and engineering content and was found to be detrimental to the Materials Engineering program. The changes created disadvantages to student recruitment and also resulted in difficulties for students in first and second year compared to the previous version of the curriculum. It is recommended that the first year be modified to better represent materials science and engineering such that students in this program have adequate training on their subject prior to entering second year. If needed, we recommend resources in the form of teaching and curriculum design support be allocated to make these improvements.
Department's Response and Actions to be Taken: We have anticipated changes in the first-year curriculum back in 2020. We carried out a gap analysis to identify topics that students who are taking the new first year courses would not be familiar. We then proceeded to change the second-year curriculum to address this. In total, 4 courses have changed in second year. We feel that our second-year program now builds on what the students learn in first year and that the students have a coherent learning experience. As for the comment concerning the impact of the changes on recruitment, we continue to work with the ELO and share feedback on the various first year projects and the way in which first year students are exposed to Materials Engineering. We feel that the ELO is a great partner and that we can work together to make first year students aware of Materials Engineering.
Dean's Response: I agree with the Department's response and action plan. The ELO is a dedicated group with expertise in pedagogy, and they are committed to continually improving the first-year curriculum (specifically ENGINEER1P13). This summer (2024) they plan to re-design one of the projects for the 2024/25 academic year. Collaboration between the Department and ELO has been very effective, and the Faculty is happy to help facilitate those interactions if it would be helpful. It is worth noting that the decline in enrollment in Materials Engineering predates 2020, which is when the first-year curriculum redesign was implemented.

Recommendation #2: Issues with the second-year teaching labs were identified by students who found the experience skewed towards report writing without enough hands-on training. It is recommended that wherever practical, hands-on work be made available and some review of the workload for lab report writing take place. Resources should be made available to address these changes if required.
Department's Response and Actions to be Taken: This comment was probably made by students who went through second year prior to the program changes that were implemented in 2021/22. In the present second year program, there are only two courses

(ENGINEER 2PX3, MATLS 2Q03) in which the students complete formal lab reports. All other courses have shifted to simple questions about the lab activities which are completed by the students during the lab.

Dean's Response:
I agree with the Department's response above. We should keep an eye on comments in the Student Course Experience Surveys to understand the students' perspectives on the balance of hands-on lab work and report writing in the updated second year curriculum

Recommendation #3:
Renovation of teaching laboratories was something planned for the near future. Considering the review of the teaching space in this exercise, it is recommended to move forward with these laboratory renovations without further delay

Department's Response and Actions to be Taken:
The aforementioned renovations have been completed and the students started using the new lab spaces this fall. In addition, the Faculty recently completed renovations to improve air ventilation and temperature control in our lab spaces. Nonetheless, several key undergraduate labs are old and in need of a renovation. The quality of our spaces does not compare well with that of undergraduate spaces in other programs. We would like to work with the Faculty on a multi-year renovation plan.

Dean's Response:
The lab space in Materials Engineering is at the top of the Faculty's list for renovations. At his time, however, the entire post-secondary education sector is in a financial crisis and there are no funds available for renovations. We will work with our Director of Advancement to prioritize fundraising in this area.

Recommendation #4:
The department has ideas to do more outreach to high school students to make the discipline of materials science and engineering more accessible. This has the potential to help recruitment and should be pursued. It is recommended that a full or part-time position be created to support the department in these efforts.

Department's Response and Actions to be Taken:
We welcome this recommendation. Recruitment/outreach is the single most time-consuming activity at the Department office. Additional resources in the form of part-time staff are greatly needed. Another possibility is to expand the role of the grad/undergrad department admins to include more work on recruitment and to compensate them for this extra work.

Dean's Response:
As mentioned above, the entire post-secondary education sector is in a financial crisis and we are not creating new positions at this time. We do have a very robust Outreach and Recruitment team who can support these efforts.

Recommendation #5:
Issues with the quality of teaching assistants remained in this review of the program despite it being an issue presented in the previous IQAP review. It is recommended that a training session is created for teaching assistants. This session should include training on how to be an effective teaching assistant and most importantly how to interact with students in a supportive manner.

Department's Response and Actions to be Taken:
This is a recurring issue that we have been working hard to address. As pointed out in the initial summary, the Department and Faculty of Engineering took several steps to improve training (this includes mandatory training and minimum language requirements). We believe that the quality of TAs has significantly improved compared to the 2016 IQAP report. We will continue our efforts in this direction. In particular, we believe that our initiatives for recruiting top students from across Canada and around the world will lead to an improvement in the TA experience. We also looking into a mentorship program to help transfer the knowledge/experience gained by graduating students to incoming TAs.

Dean's Response:
It is good to hear the quality of TAs has increased over the last eight years. This indicates the actions the Department is taking towards improving TA performance is effective. TA training is required and is offered each semester through the MacPherson Institute – McMaster's centre for leadership in teaching and learning. TA training hours are counted in the TA hours of work as per the collective agreement between the TA union and McMaster University. It is worth noting that the Faculty did try to implement its own training several years ago to include engineering-specific information. However, we found that MacPherson's TA training is as effective as our own, and so we have deferred this work to them.

Recommendation #6:
Students felt unsupported or unequipped to deal with potential issues of harassment while on co-op work terms. It is recommended a training session on workplace harassment be provided prior to a student's first work term. This session should help them understand workplace harassment, how to identify it, strategies to deal with it, and a list of resources available to report anonymously and get support.

Department's Response and Actions to be Taken:
We take this concern very seriously and we are committed to working with the coop office to address this concern. Our colleagues in Engineering Coop Services have outlined three key initiatives that will improve our ability to support the students:

1. **Enhancements to ENGINEER 1EE0: Introduction to Engineering Co-op Program**

   Upon enrollment in a Co-op program, Engineering Co-op students are required to complete ENGINEER 1EE0; a virtual course delivered asynchronously over a 5-week period (offered in both fall and winter academic terms). At present, 1EE0 focuses primarily on job search activities and the process for securing a co-op experience. Effective Fall 2024, enhancements to content within 1EE0 will support students from a much wider spectrum of relevant topics including self awareness, career development, job search and employment success. Within this scope we will include an introduction to:

- Understanding workplace culture
- The transition from student life to the workplace
- Understanding employment, legal and human rights
- Harassment, discrimination and workplace safety
- Who to contact for support (including at the workplace and within ECCS)

2. **Introduction of a "Professionalism & Workplace Preparation" workshop for students on work term**

In addition to the above enhancements to existing programming, ECCS is also developing a new mandatory workshop that students will complete within the first 2 weeks of starting a co-op position. While onboarding into their first co-op experience, they will complete an online workshop that revisits and reinforces content related to workplace culture, employment/legal/human rights, harassment/discrimination and workplace safety through a more in-depth session. Students will be equipped with resources and key contacts for support.

In addition, students will be reminded about how to access their Career Educator throughout their co-op experience, and their Career Educator will proactively reach out at key points in the work term experience as a check-in and progress measure.

3. **Quality assurance guidelines for employer partners**

ECCS employs a team of Talent Partnership Consultants who focus exclusively on activities associated with sourcing/identifying and engaging employers as partners in student recruitment and through affiliation/partnership with other areas of Engineering. As part of this work, the Talent Partners communicate expectations related to student hiring and build a relationship that supports the development of meaningful student experiences. If issues arise while a student is employed at one of our partner organizations, our Talent Partners are a first point of contact for these employers and they liaise between our student-facing team members and the employer, as required, in order to address issues and come to resolution. This includes liaising with other campus offices (such as Legal Services and University Health & Safety) in situations that warrant this expertise.

Additionally, ECCS is collaborating with other Faculty-based co-op/career offices at McMaster to draft and implement a set of institutional guidelines and expectations for ethical recruitment practices and student work experiences.

Dean's Response:

Our co-op program has experienced tremendous growth over the past decade, as has the co-op and Career Services Office that supports the program. They are continuously introducing and improving programming and resources to ensure that all students in our Faculty are career ready, regardless of whether they are enrolled in the Co-Op program. As indicated above, our Talent Partners are the first point of contact when issues arise on co-op; however, as the program grows and new issues arise, we are recognizing the need for a comprehensive set of guidelines and policies to address them. To that end, the Engineering Co-Op and Career Services Office is

contributing to drafting and implementing institutional guidelines and expectations for ethical recruitment practices and student work experiences.

Starting this year, students now have access to all university Student Services during their co-op placements, in addition to the services provided by our Engineering Co-Op and Career Services Office.

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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)
#1 Impact of First Year Curriculum:	*Redesign of the 2nd year curriculum has already been undertaken. *Continuous communication with the 1st year team.	*Program Chair. *Dr. Bryan Lee, materials representative on the 1st year curriculum team.	*Already completed.
#2 Second Lab Reports	*Number of reports has been substantially reduced. *Small group will be convened to determine if the implemented changes had the desired effect.	*Department Chair.	*Workload has been revisited. *Evaluate if this had the desired outcome by meeting with the students in May 2024.
#3 Renovations of Lab Spaces	*Lab renovations have been completed. The labs are completely functional. No urgent changes are needed. *In terms of aesthetics/ appearance of the space, fundraising proposals will be prepared for support upgrade especially of the hallways and meeting rooms.	*Department Chair to work with Director of Advancement.	*Lab renovations have already been completed. *First meeting with fundraising team took place to identify potential proposals. *Meetings will take place every 6 months. *Timeline details depend on available opportunities.
#4 Outreach	*Expanded outreach efforts will be pursued using existing resources.	*Department Chair.	*New outreach initiatives have already been implemented.

			First Materials Olympics took place last February.
#5 TA Training	*Continue existing TA training programs. *Better match TAs with their topics of expertise. *Ask instructors to provide TAs with more detailed instructions and if needed learning resources related to the course content.	*Associate Chair- Graduate.	*New steps will be implemented in Sept. 2024. *Evaluations of the effectiveness of the new approach will be reviewed in May 2025.
#6 Support students during internships	*ECCS has implemented a three-point plan as outlined above. *Students will have access to all student-support resources while on coop.	*Engineering Coop and Career Services. *Department Chair.	*New processes and supports will be in place as of May 2024.

Quality Assurance Committee Recommendation:

McMaster's Quality Assurance Committee (QAC) reviewed the above documentation at the May 2024, meeting. The committee recommends that the **Materials 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.