FINAL ASSESSMENT REPORT

Institutional Quality Assurance Program (IQAP) Review

ELECTRICAL AND COMPUTER 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 Electrical and Computer 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.

<u>**Executive Summary of the Review**</u>

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 Electrical and Computer 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, Chair of the Department, and Associate Chair (Undergraduate) submitted responses to the Reviewers' Report. The initial response was prepared by the program in June 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

- An excellent departmental continuous program improvement structure and process.
- The department's instructors, through their diversity of their backgrounds, experiences, knowledge, biases, etc., continue to choose and adopt a wide scope of delivery and assessment methods, from classical/traditional ones to very recent and innovative ones.
- Engineering 1 students are well trained in core technical courses and incorporate project-based learning experience (PBLE). PBLE develops critical thinking together with analytical skills.
- A common first year allows students to get exposure to different areas of engineering before committing to a specific field.
- The Design Spine in the program, including the corner stone and capstone design courses, is at the forefront of recent innovations in the teaching of engineering design. Students have opportunities to work in multi-disciplinary teams and to develop their teamwork, communications, and other soft skills in the context of engineering design projects and experiential learning opportunities at increasing levels of complexity.
- The department has recently significantly increased its complement of teaching staff which will help address the increasing number of students.
- The ECE department is investing in state-of-the-art equipment/software, which enhances student learning experience.

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

> **Recommendation #1.1 (Program):**
> **Develop a continual evaluation and improvement process for the courses in the design spine.**

Department's Response and Actions to be Taken:

The Faculty of Engineering has a well-established continuous improvement process, as required by the Canadian Engineering Accreditation Board (CEAB). The Graduate Attributes listed in the IQAP self study are based on a set of 30 indicators (40 prior to 2022), which have been defined across the Faculty of Engineering and are continuously measured within our department. These measurements and are mapped to individual courses, where they are then connected to specific course learning objectives. In this way, every attribute is measured in at least two different courses throughout the program, and almost every attribute is measured multiple times every year. The purpose of these measurements is to implement a continuous improvement process for students' knowledge, experience, program, and course delivery. The data from these measurements are reviewed at our annual Stakeholders Committee meeting, and subsequently the Faculty Graduate Attributes Committee. These measurements together with results from the Student Course Experience Surveys are discussed by the Stakeholder Committee and Curriculum Committee within the Department, and the Graduate Attribute Committee at the Faculty level. The outcomes from these meetings inform program and course updates within our continuous improvement process.

Dean's Response:

The Graduate Attribute Continuous Improvement (GACI) process was adopted by Engineers Canada in 2008 and fully implement within our Faculty by 2014. It has been demonstrated to be effective and has been vetted over two CEAB accreditation visits (2015, 2021).

Recommendation #1.2 (Program):
Include more Engineering and Society topics/courses in the regular program.

Department's Response and Actions to be Taken:

Through the faculty's experiential learning office (ELO), we will invite instructors from other departments and faculties to give 1~2 guest lectures on various engineering and society topics in our fourth-year regular courses, at least one course in each of the following streams: computer engineering, microelectronics and fields, SPCC (signal processing, communication, and control), power engineering, and biomedical engineering. We will adjust the outlines of courses addressing emerging technologies such as machine learning and electrification to discuss the ethical application of these technologies and their effect on society.

Dean's Response:

I recommend you encourage your students to take CHALLENG 2CC3 - Engineering and Science for Humanity's Critical Challenges. This course is offered by Engineering Physics and is open to all students across the university. This course explores the role of engineering and science in addressing four critical challenges for humanity: energy sources for the future; climate change; deployment of artificial intelligence and biotechnology; and confronting the prospects of nuclear war and high-impact pandemics.

Recommendation #2.1 (Admission Requirements):
Address the issue of high school grade inflation through a review of admission policies, or through other initiatives.

Department's Response and Actions to be Taken:
The Faculty of Engineering is fully aware of the issue of high school grade inflation especially during the COVID-19 pandemic. The COVID-19 pandemic period resulted in a wave of students who were less prepared for our program than in previous years, as evident from the collected feedback from many instructors. We plan on helping these underprepared students by offering summer courses that would allow students to catch up if they fail key courses the first time.

Additionally, the Faculty of Engineering use a supplementary application and considers this alongside grades in a holistic admission process. The supplementary application assesses key competencies such as how applicants approach and think through a question, how articulate they are in their answers, and how engaged they are in the process. This helps us differentiate between students with high grades and admit students with competencies and interests that match our programs. The success of this process is demonstrated, in part, through our low attrition rates.

Dean's Response:
The Department is commended for adding summer courses to ensure their at-risk students do not fall behind when they do not pass key courses the first time. This approach also allows students to lighten their loads during the semester and make it up in the summer without lengthening their programs. For multiple reasons, this approach improves access and equity within the department.

Recommendation #2.2 (Admission Requirements):
Increase the attractiveness of the Electrical Engineering program to first year students.

Department's Response and Actions to be Taken:
One major problem we face in ECE is that the physics courses in the first year seem to discourage students from joining ECE and few other departments. We propose to send two or three of our ECE instructors to give 2~3 guest lectures in the first-year physics course. This will help students connect the abstract concepts to real-world applications. We also propose to add a mini project module on electric cars in ENGINEER 1P13. We believe that the increased exposure of the first-year students to electrical and computer engineering will help to attract them to our program.

Dean's Response:
You may consider implementing an initiative like Engineering Physics, in which they advertise help sessions for students in level 1 physics for engineers. This is an innovative way to foster engagement with first year students and provide an introduction to the Department of ECE. This can provide them with valuable insights into the Department and its discipline.

You may also consider highlighting the ECE-related clubs and teams, such as Eco Car and the DOD Battery Challenge, for first year students. Since it is hard for first year students to procure spaces on clubs and teams in their first year, you could consider asking engaged upper year students to mentor a year 1 student who has interest in their field.

Finally, you could consider co-hosting a workshop with the ELO to revamp at least one project that highlights an area of Electrical or Computer Engineering that has been identified as being of interest to prospective students. When you have identified an area, consider including another department with synergistic expertise.

Recommendation #3.1 (Curriculum):
Train and assist instructors for incorporating principles of universal design for learning in their courses.

Department's Response and Actions to be Taken:
Several of our instructors are aware of the principles of universal design for learning (UDL) and are incorporating them into their courses. More work is needed to improve awareness of these principles and implement them in all our courses. We plan to work with the MacPherson Institute on organizing a series of lectures focusing on UDL. In fact, prior to receiving the current IQAP report, we invited colleagues from the MacPherson Institute to introduce UDL in our department retreat on May 11, 2023. We will continue to train our instructors on these principles and evaluate their implementation.

Dean's Response:
The Associate Dean Undergraduate is running a pilot project during the summer 2024 and is seeking instructors to join. The project will support the integration of UDL principles into an existing course through one-on-one meetings with an educational developer, as well as creating a community of practice among a group of faculty members who are integrating UDL principles into their courses. I strongly encourage ECE to participate in this project to increase instructor awareness about UDL, and begin developing a culture where UDL principles are regularly integrated into their courses.

Recommendation #5.1 (Resources to Meet Program Requirements):
Engage a greater variety of stakeholders in laboratory curriculum development.

Department's Response and Actions to be Taken:
The Department of Electrical and Computer Engineering realizes the importance of practical laboratory experiments in enhancing the knowledge of our students. We are continuously updating our laboratories with state-of-the-art equipment to give our student the best learning experience possible. To engage a greater variety of stakeholders, we will invite alumni and industrial stakeholders to visit our undergraduate labs and to collect their comments and suggestions. An industrial advisory board, which will be established during the academic year 2023/2024 can play a role in this curriculum development. We will also actively engage with hardware and software vendors to seek various opportunities for collaboration. We will organize events for these vendors to show their most advanced tools and to inform our instructors of the recent technological advances in laboratory equipment. We will continue collecting feedbacks from students and TAs about possible changes that would help to improve the laboratory experience.

Dean's Response:
A stakeholder committee, which includes internal and external stakeholders, is a part of the Graduate Attributes and Continuous Improvement (GACI) process described in response to Recommendation 1.1.

During the 2023/24 academic year, the Associate Dean's office developed a best practices document for interacting with the GACI stakeholder committee. The document describes ways in which the Department can engage stakeholders more deeply in the curriculum planning, development, and improvement processes. The Department is strongly encouraged to use this document to guide their interactions with their stakeholder committee.

Recommendation #5.2 (Resources to Meet Program Requirements):
Develop a strategic teaching and research faculty recruitment plan.

Department's Response and Actions to be Taken:
All hirings in the ECE Department are carried out based on local discussions during department meetings and meetings of the Chair's Council. The Department recruits new faculty members based on the retirement of faculty members, areas of growth with existing supportive infrastructure such as electrification and biomedical engineering, and recruitment opportunities in emerging technologies. We also recruit teaching-track professors in different areas of electrical and computer engineering as needed. The Chair of the Department is asked to submit a recruitment plan to the Dean of Engineering that discusses the merits of the recruitment plan. The Department proceeds to take hiring plans only after receiving approval from the Dean's office. For all hirings within the next 5 years, we will engage all colleagues in discussions on potential areas for recruitment that best serves the growth targets of the Department.

Dean's Response:
The Department is encouraged to consult with their Stakeholder Committee in developing these plans to ensure industry relevance in our evolving markets and economies.

Recommendation #6.1 (Quality Indicators):
Secure university resources for increased availability of high-quality teaching and learning spaces, and student to faculty ratio reduction.

Department's Response and Actions to be Taken:
Like all major Canadian Universities, McMaster University, due to the large growth, is having space shortage. This is not affecting only the ECE Department but all other Departments across the University. To help accommodate the growth in our faculty members, a space audit was carried out during the summer of 2022. A meeting of the Space committee was held afterwards. Few recommendations were implemented that freed more space and allowed us to accommodate the new faculty members hired between July 2022 and July 2024. We are working closely with the Dean's Office to remodel three different spaces in both the ITB Annex and CRL buildings. This remodelling will create 4 more faculty offices, and 1,600 square feet research area. At least 5 faculty members and 40 graduate students will benefit from these areas. Also, the Faculty of Engineering is developing a plan for a new Engineering building that will hopefully supply more high-quality teaching and learning areas. Our target is to continue to do more with the space we currently have while waiting for more space to be created through new buildings.

  To improve the student to faculty ratio, we hired 10 faculty members between July 2022 and July 2023. These new hirings will allow us to better handle the current enrollment numbers and offer a more diverse collection of elective courses and graduate courses. We plan to hire two more biomedical

professors during the academic year 2023/2024. There is a discussion with the Faculty to hire one faculty member in the area of computer engineering to replace a retired colleagues. The Faculty approved hiring one more technical staff as of July 2023 to assist with our undergraduate laboratories. The ECE Department, in coordination with the Faculty of Engineering, will continue hire more talented researchers and instructors subject to the budgetary constraints and the rising opportunities.

Dean's Response:
Teaching spaces are controlled centrally by the Registrar's Office and are beyond the Faculty's control.

The Department is commended on 10 excellent hires since July 2022. Currently, the post-secondary sector is in a budget crisis, across Canada and particularly in Ontario. All faculty hiring has been paused until this situation turns arounds.

Recommendation #6.2 (Quality Indicators):
Inform future departmental decisions through a more extensive analysis of available quality indicator metrics.

Department's Response and Actions to be Taken:
All decisions taken at the ECE Department are discussed in different committees, in meetings of the Chair's Council, and in Departmental meetings. The Department administration bases their decisions on solid data and feedback from students, faculty, and staff. We do our best to inform all colleagues of the background and motivation for different decisions. For example, an Equity Diversity and Inclusion (EDI) committee was recently formed by the Chair. One example is the new Career Merit Point (CPM) allocation procedure adopted by the Department. This CPM system evaluates the performance of all faculty members in teaching, research, and service. Because the previous system was not effective and lacked transparency, a new system was developed after discussions with the previous department chair and two chairs from other Departments. A full Department meeting was spent on explaining how this system, which is based on self-evaluation, works. The new system according to available data was 90% accurate in predicting a fair CPM allocation. The Chair communicated to the Department why the system did not work in the remaining 10% of cases and collected feedback on possible improvement steps. We will continue in ECE to engage all students, faculty, and staff in the decision-making process to ensure that all voices are being heard.

Dean's Response:
We have several mechanisms in place to inform decision making, for example the GACI process and stakeholder committee. The ECE Department is commended for its positive changes and transparency that has been implemented over past several years.

Recommendation #7.1 (Program Enhancement):
Consider the creation of a community of practice in Engineering Education in collaboration with the MacPherson Institute.

Department's Response and Actions to be Taken:
The members of our ECE's teaching development committee naturally forms a community of practice in Engineering Education. We will establish a regular meeting system with colleagues in the MacPherson Institute. As such, the members in our ECE's community will have the opportunity to continuously update their knowledge and improve their skills in Engineering Education through communications and interactions with the MacPherson Institute.

Dean's Response:
ECE does an excellent job of fostering excellence in teaching and learning among its faculty members. They host an excellent guest lecture series. The Associate Dean's office will be working to develop a community of practice around UDL during the summer 2024 semester. Additional interactions in this space are always encouraged, particularly with MI.

Recommendation #8.1 (System of Governance):
Review and reform decision-making structures and processes to be more strongly aligned with principles of equity, diversity, and inclusion.

Department's Response and Actions to be Taken:
The ECE Department, Faculty, and University work hard to adhere to best practices related to EDI. There are always some shortcomings, but the administration is keen on upholding these principles through various initiatives within the Department.

A new EDI committee was formed in November 2022 to organize events that promote EDI in the ECE Department. This committee has been active, for example implementing an EDI lecture series with prominent speakers to discuss different issues related to EDI.

All search committees have an Employment Equity Facilitator to ensure that all EDI principles are observed throughout the process, and all members must undergo unconscious bias training. These practices have proven effective, as the Department successfully recruited two Black faculty members through the Black Excellence cohort hiring process in 2022, as well as an Indigenous staff member in 2023. Both Black and Indigenous identifying people are underrepresented in the Faculty.

We will continue to improve the implementation of these procedures to maintain a fair environment for all ECE members.

Dean's Response:
The Department is praised for establishing an Equity, Diversity, and Inclusion (EDI) committee and for making significant progress in this domain. The committee is encouraged to pursue ongoing education and development alongside the Department in advancing equity, diversity, and inclusion efforts.

Recommendation #9.1 (Academic Services):
Review the academic advising process in order to determine if changes and improvements are needed.

Department's Response and Actions to be Taken:

We agree with this comment; however Academic Advising is central to the Faculty and therefore beyond the Department's purview.

Dean's Response:
Academic advising is central. We suspect this comment stems from timetabling processes, which historically have 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.

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	Timeline for Completing Action
#1.1 Develop a continual evaluation and improvement process for the courses in the design spine.	Form an extra teaching cluster for the courses in the design spine and have yearly meeting.	**ECE's UG Associate Chair**	**Dec. 2023**
#1.2 Include more Engineering and Society topics/courses in the regular program.	Invite instructors from other departments and faculties to give 1~2 guest lectures on various engineering and society topics in our fourth-year regular courses. Adjust course outlines addressing machine learning and electrification to discuss the ethical application of these technologies and their effect on society.	**ECE's UG Associate Chair**	**May 2024**
#2.2 Increase the attractiveness of the Electrical Engineering program to first year students.	Send two or three of our ECE instructors to give 2~3 guest lectures in the first-year physics course. Propose to add a mini project module on electric cars in ENGINEER 1P13.	**ECE's UG Associate Chair**	**May 2024**
#3.1 Train and assist instructors for incorporating principles of universal design for learning in their courses.	Work with the MacPherson Institute on organizing a series of lectures focusing on UDL. We will continue to train our instructors on these principles and evaluate their implementation.	**ECE's UG Associate Chair**	**May 2024**

#5.1 Engage a greater variety of stakeholders in laboratory curriculum development.	Invite alumni and industrial stakeholders to visit our undergraduate labs and to collect their comments and suggestions. Form an industrial advisory board for curriculum development. Engage with hardware and software vendors to seek various opportunities for collaboration by organizing events for those vendors to show their most advanced tools and to inform our instructors of the recent technological advances in laboratory equipment. Continue collecting feedbacks from students and TAs about possible changes that would help to improve the laboratory experience.	**ECE's Chair and UG Associate Chair**	**Dec. 2024**
#5.2 Develop a strategic teaching and research faculty recruitment plan.	Engage all colleagues in discussions on potential areas for recruitment that best serves the growth targets of the Department for all hirings within the next 5 years.	**ECE's Chair**	**Dec. 2027**
#6.1 Secure university resources for increased availability of high-quality teaching and learning spaces, and student to faculty ratio reduction.	Hire two more biomedical professors during the academic year 2023/2024. Continue hire more talented researchers and instructors in coordination with the Faculty of Engineering, subject to the budgetary constraints and the rising opportunities.	**ECE's Chair**	**Dec. 2024**
#7.1 Consider the creation of a community of practice in Engineering Education in collaboration with the MacPherson Institute.	Establish a regular meeting system with colleagues in the MacPherson Institute so that the members in ECE's community will have the opportunity to continuously update their knowledge and improve their skills in Engineering Education.	**ECE's UG Associate Chair**	**Dec. 2024**
#9.1 Review the academic advising process in order to determine if changes and improvements are needed.	Initiate a review procedure with help from members of the Chair's Council. Collect feedbacks and suggestions from the Department meeting. Implement a new academic advising process.	**ECE's Chair**	**Jan. 2024**

<u>Quality Assurance Committee Recommendation:</u>

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