FINAL ASSESSMENT REPORT
Evaluation of Graduate Programs

School of Electrical Engineering and Computer Science (EECS), University of Ottawa
Department of Electronics (DOE), Carleton University
Department of Systems and Computer Engineering (SYS), Carleton University

Ottawa-Carleton Institute for Electrical and Computer Engineering (OCIECE)[1]

Cycle: 2020–2021
Date: December 21, 2022

I. Evaluated Programs: Graduate Programs

- Master of Engineering in Electrical and Computer Engineering (MEng)
- Master of Applied Science in Electrical and Computer Engineering (MASc)
- Doctor of Philosophy in Electrical and Computer Engineering (PhD)

II. Outline Evaluation Process (outline of the visit)

The Final Assessment Report for the evaluation of the programs was based on the following documents: (a) the self-study brief produced by the academic unit, (b) the report produced by the external reviewers following their site visit, and (c) the responses to those documents from the Deans, Jacques Beauvais, Faculty of Engineering at the University of Ottawa, and Larry Kostiuk, Faculty of Engineering and Design at Carleton University, Program Director, Pierre Payeur (EECS), Associate Chairs for Graduate Studies, Rony Amaya (DEO) and Amir Banihashemi (SYS).

The site visit, which took place on November 25–26, 2021, was conducted by Yahia Antar, Department of Electrical and Computer Engineering, Royal Military College, and Hamadou Saliah-Hassane, Department of Science and Technology, TELUQ University.

The visit was carried out virtually due to the SARS-CoV-2 pandemic. The evaluators were provided a comprehensive self-study brief that had been previously presented and discussed at the School Assembly prior to revision. In addition, they had the opportunity to see the physical space through a virtual tour.

During the visit, the evaluators met with the following individuals:

- Senior Management: Claire Turenne-Sjolander, Vice-provost (Graduate and Postdoctoral Studies), Ottawa, Dwight Deugo, Vice-Provost and Associate President (Academic), Carleton.
- Program Leadership: Abdulmotaleb El Saddik, OCIECE Director, uOttawa, and Rony Amaya, Associate Director OCIECE, Carleton.
- Department Chairs and Directors: Claude D'Amours, Director, EECS, Ottawa, Jiying Zhao, Graduate Associate Director (Electrical and Computer Engineering), EECS, Ottawa, Yvan Labiche, Chair, SYS, Carleton, Amir Banihashemi, Associate Graduate Chair, SYS, Carleton, Niall Tait, Chair, DOE, Carleton, Rony Amaya, Associate Director OCIECE, Carleton, Abdulmotaleb El Saddik, OCIECE Director, Ottawa.
- Faculty Members from Ottawa and Carleton.
- PhD students from both Ottawa and Carleton.

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[1] For this evaluation, the University of Ottawa was the leading institution.

- MASc and MEng students from both Ottawa and Carleton.
- Deans: Jacques Beauvais, Dean, Faculty of Engineering, Ottawa, and Larry Kostiuk, Dean, Faculty of Engineering and Design, Carleton; and Patrice Smith, Dean, Faculty of Graduate and Postdoctoral Affairs, Carleton.
- Ottawa and Carleton Administrative Staff.

III. **Summary of Reports on the Quality of Programs[2]**

1. **EMPHASIZING THE STRENGTHS AND IDENTIFYING CHALLENGES**

   STRENGTHS

   - The vitality of the programs is demonstrated through its outputs, including international publications.
   - Strong emphasis is placed on experiential learning and collaboration with the industry.
   - The geographical location, which includes both industry (e.g. Kanata North) and government laboratories, is ideal for training highly qualified personnel.
   - There is a synergy with other Engineering programs, including the Ottawa-Carleton Institute for Biomedical Engineering (OCIBME).
   - There is a strong alignment with emerging areas such as artificial intelligence-enabled 6G networks, the Internet of Things (IoT), and machine learning.
   - Most of the students are well funded.
   - The programs provide a unique training environment, where students can take courses at both institutions, University of Ottawa and Carleton University.

   CHALLENGES

   - Since a large number of courses have not been offered in over three years, there is a need to review the curriculum.
   - Students want to have more choices and more up-to-date courses.
   - Given the available resources, delivering two master's programs (MEng and MASc) is challenging.
   - Ways to strengthen the connection with the Franco-Ontarian community in keeping with the strategic plan of the University of Ottawa.

2. **PROGRAM OBJECTIVES**

   - The external evaluation found that the OCIECE programs were well aligned with the strategic plans at both institutions.
   - The hands-on nature of the programs is in line with both institutions' goals of strengthening and expanding experiential learning for all students. This appears to be a distinctive feature of the MASc when compared to similar programs at other Canadian institutions.
   - The authors of the self-study reported that the MEng program is working to improve learning outcomes related to "research and scholarship" and "the ability to perform independent self-study."

3. **CURRICULUM AND STRUCTURE**

   - The external reviewers noted that admission requirements are aligned with the learning outcomes. They also indicated that differences exist between the admission

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[2] Based on every document prepared during the assessment process, often extracted verbatim.

process at the two universities. The three academic units as well as the two deans, in their response, indicated that such differences are unavoidable given that the University of Ottawa and Carleton University are two distinct institutions.

- All stakeholders involved in the review agree that the curriculum needs to be reviewed in order to remove courses that have not been offered in several years and to continue the ongoing efforts to create new courses for emerging areas. The leadership of the programs has already started this process.

- The authors of the self-study have identified the need to enhance professional/soft skills.

4. **TEACHING, LEARNING AND EVALUATION METHODS**

- The external reviewers wrote, "We found that the teaching methodologies are very effective and allow the students to achieve and excel in achieving the required objectives." They also recommend enhancing exposure to conferences, seminars, and societies.

- MEng program enrollment has increased significantly in recent years. Professors and students alike expressed concern about the negative consequences of such large enrollments. The increased class size has limited instructors' ability to assign class projects and engage students in class presentations (In 2021-2022, four courses had enrollments ranging from 36 to 68 students). It has been proposed to form an ad hoc committee to make appropriate recommendations in this regard.

5. **STUDENT EXPERIENCE AND GOVERNANCE**

- According to the external reviewers, students are generally satisfied with most aspects of their program. However, some students appear to be confused regarding the process for the comprehensive PhD examination (see Recommendation #5). Overall, the students interviewed seemed satisfied with the professors' supervision.

- The admission statistics show that there is a need to increase both the number of domestic students and the gender diversity.

6. **PHYSICAL AND HUMAN RESOURCES**

- "Overall, most of the students are well financially supported. Both universities are making good effort toward that. However, some of [the] students at Carleton expressed concerns about uniformity and the availability of consistent support."

- A number of indicators point to high employability. However, it would be valuable to develop better mechanisms to track the trajectory of the students after graduation and gain additional insights into this question.

IV.   **Program Improvements**

> The programs under evaluation are in conformity with the standards of the discipline. The following recommendations aim at maintaining or increasing the level of quality already achieved by the programs.

Recommendation #1: Improvement of courses offered.

Recommendation #2: Pursue the experimental learning to suit students' expectations.

Recommendation #3: Harmonization of admission and assessment processes in the joint program.

Recommendation #4: Harmonization of financial support.

Recommendation #5: Clarifying comprehensive exams processes for students.

V. **Conclusion**

OCIECE offers research intensive MASc and PhD programs, as well as a professional Master of Engineering (MEng) program. The external evaluation found "the program[s] to be very effective and provide excellent training," "achieves the objectives," the "outputs of the program[s] in terms of research and training are and continue to be excellent." The geographical location, which includes both government laboratories and Canada's largest technology park (e.g. Kanata North), was noted as one of the strengths of the programs, as well as the alignment with emerging areas and the hands-on nature of the training.

The recommended improvements include a review of the course offerings in order to remove from the curriculum courses that have not been offered in several years, and to develop new courses in emerging areas. Finally, this evaluation proposes that the comprehensive examination processes be reviewed and clarified.

The committee members would like to thank all participants for their contributions to the program evaluation.

Schedule and Timelines

A progress report that outlines the completed actions and subsequent results will be submitted to the evaluation committee by December 15, 2024.

The next cyclical review will take place in no more than seven years, in 2027–2028. The self-study brief must be submitted no later than June 15, 2027.

Unit Response and Action Plan

Faculty:

- Faculty of Engineering

Programs evaluated:

- Master of Engineering in Electrical and Computer Engineering (MEng)
- Master of Applied Science in Electrical and Computer Engineering (MASc)
- Doctor of Philosophy Electrical and Computer Engineering (PhD)

Cyclical review period:

- 2020-2021

Date:

- July 19th, 2022

Note: This document is submitted to the Senate, as well as the Quality Council, and will be published on the University Web site.

General comments:

On April 19th, 2022, the M.Eng., M.A.Sc., and Ph.D. Electrical and Computer Engineering graduate programs were made aware of the External Review Report produced in the context of the cyclical program evaluation. We were extremely pleased with the positive evaluation of our graduate programs. Given that the Electrical and Computer Engineering graduate programs are committed to provide an outstanding training and research experience, we were gratified to see that the external reviewers found our "program to be very effective and provide excellent training and achieves the objectives as outlined in the strategic plans", that "the outputs of the program in terms of research and training are and continue to be excellent", that "students met seem to be happy and enjoying their experiences", and that "it is moving in the right directions and is aligned with the state of the art in research and future directions in emerging areas." In sum, external reviewers confirmed that "the program also complies with the requirements of the Ontario Universities Council for Quality Assurance Audit process." The report makes five recommendations which are all considered high priority. We take the recommendations seriously and feel confident that by addressing them as extensively as possible under our joint administrative structures, our graduate programs will be even more effective. The recommendations and our response, produced jointly by the three units (EECS at UOttawa; SCE and DOE at Carleton) and the Faculty of Engineering, are included below.

Recommendation 1: Improvement on courses offered.

Unit response: Reviewers' comments targeted two main actions to be undertaken: 1) cleaning up courses not delivered for long, and 2) offer some fundamental courses in core areas.

Item 1) A major cleanup was initiated prior to this cyclical evaluation process, leading to 22 courses at EECS, 20 courses at SCE, and 15 courses at DOE to be identified for deletion given that they were not offered for several years, and some became less relevant.

Current status: All EECS courses except one have already been deleted from uOttawa calendar. Administrative procedures are on-going for deleting the remaining course. Deletion of SCE and DOE courses from the calendar at Carleton is programmed for Fall 2022.

Item 2) Our programs already offer fundamental courses in a wide variety of core areas. The offer is continuously revisited and improved in accordance with the arrival of new technologies and market trends. For example, new courses in machine learning, robotics, wireless networks, ubiquitous sensing, smart cities, cloud computing, ethics for AI and robotics, photonics, etc. were introduced over the recent years. Additional courses are planned for the coming years that address areas in demand, in correlation with the hiring of new professors in strategic areas. The latter include courses on predictive control theory, quantum mechanics, data visualization, software systems, cybersecurity. It remains OCIECE's goal to offer courses that meet the evolving demand from industry while exposing our graduate students to a wide variety of much needed fundamental concepts that characterize our domain.

Ottawa decanal response: I agree with the Unit response which addresses the recommendation directly and clearly, and proposes to continue actions already undertaken to cleanup courses not delivered in recent years and to continue to revise the course offer on an ongoing basis.

Carleton decanal response:

With respect to course cleanup, this is a welcome recommendation and fits well with Carleton's renewed interest in honestly representing our course offerings to better meet any expectations of prospective students. As described, progress has been made in this regard, it will continue, and has the full support of the Faculty of Engineering and Design.

With respect to fundamental course offerings, the Faculty of Engineering and Design at Carleton University is fully aligned with the Unit's response.

Priority Level*	Actions to be undertaken	Assigned to	Timeline	Curriculum change?
1	Courses cleanup	J. Zhao (grad coordinator, EECS) R. Amaya (grad coordinator, DOE) A. Banihashemi(grad coordinator, SCE)	Fall 2022 Fall 2022 Fall 2022	No
1	Improve course offering in core areas	J. Zhao (grad coordinator, EECS) R. Amaya (grad coordinator, DOE) A. Banihashemi(grad coordinator, SCE)	Continuous process with yearly update	Yes

* PRIORITY LEVEL: 1. URGENT-IMMEDIATE ACTION REQUIRED 2. IMPORTANT-ACTION REQUIRED WITHIN 18 MONTHS (MAXIMUM) 3. ADVISED: DEVELOPMENT AND STRATEGY-ACTION TO BE DISCUSSED AND MUST BE IN PLACE BY MID-CYCLE (WITHIN 4 YEARS)

Recommendation 2: Pursue the experimental learning to suit students' expectation.

Unit response: Reviewers' comments pointed toward two main pathways to expand on experimental learning: 1) invest in lab equipment, and 2) enhance ties with industries and government labs.

Item 1) Graduate students pursue experimental learning largely through the research work they conduct in relation with their thesis, or through project-based learning. While some areas of research may not involve massive infrastructure, research projects conducted in our two faculties of engineering naturally connect with down-to-earth applications and are therefore grounded in experimental learning. Additionally, our three units count on a large number of research laboratories equipped with state-of-the-art technologies covering the numerous specializations of electrical and computer engineering. Students are given the opportunity to acquire hands-on experience on such equipment. The expansion of our research infrastructures is a constant work in progress as it largely depends on securing external grants from agencies such as NSERC or CFI, and on establishing partnerships with industry. All OCIECE faculty members are contributing to this journey, by continuously seeking new grants to develop the research infrastructure. Our faculties were very successful in the recent years at attracting such funding, which led to the opening of new research and training facilities (e.g., the recently opened Smart Connected Vehicles Innovation Centre at uOttawa's Kanata-North campus, the uOttawa-IBM Cyber Range, the Canadian Futuristic Health Data Visualization Center, and the Tissue Engineering & Applied Materials (TEAM) Hub at Carleton). Recent efforts also led to the expansion and modernization of existing research infrastructures on the main campus (e.g., massive labs in the recently built STEM and ARC buildings). In the case of M.Eng. students who are not involved in writing a thesis, a 6-credit project in electrical engineering or an alternative internship in industry, banks, or government agencies exposes them to experiential and experimental learning. As such, many M.Eng. students conduct a 2-semester project under the supervision of OCIECE members and are then given access to their research infrastructure. At the same time, they get to interact with other graduate students involved in the research groups and acquire conceptual knowledge as much as practical skills from this experience.

Item 2) Interactions with the industry and government labs in the national capital region are already very active. OCIECE members pursue numerous research contracts and industrial partnerships with companies and government agencies in the Ottawa-Gatineau area or elsewhere in North America and abroad. External partnership programs (e.g., NSERC Alliance, Mitacs Accelerate, etc.) are extensively used to secure research funding for such partnerships and consequently provide graduate students with an immersive learning experience while they pursue part of their graduate studies journey on our partners' premises. Collaboration between our research groups and several SMEs is taking place on a continuous basis, while strategic partnerships are also established with major players, such as IBM Canada in cybersecurity, Nokia-Bell, etc. The uOttawa's Kanata-North campus also plays a catalytical role at connecting research with the high-tech industry concentrated in the Kanata area. It is frequent that OCIECE members along with our graduate students perform research, publish articles and file patents in collaboration with industry and government agencies. Our coop offices are also deeply involved in making ties with industry and provide opportunities for our graduate students, especially in the M.Eng. program., to acquire experience. As a result, many receive job offers even before they graduate.

Ottawa decanal response: I agree with the Unit response. Researchers that are engaged in OCIECE have achieved great success recently in CFI-JELF grant applications and in particular are currently fully engaged in the follow-ups to two successful CFI Innovation Fund grant applications that amount to close to $40M in infrastructure. The launch of the Smart Connected Vehicles Innovation Centre in Kanata North, coupled to these major grants are clear indications of the current major upgrade to the equipment infrastructure that will directly benefit the OCIECE students. In addition, the SCVIC in Kanata North, the Cyber Range, and the presence of uOttawa in the new Hub350 space in Kanata North (in addition to our own facilities) are indications of the significant importance for us of engaging with industry. All of these steps, in addition to the individual researcher engagement activities, will result in a major enhancement of interactions with industry and government currently and in the near future.

Carleton decanal response:

The pathways identified in this recommendation to enhance experimental learnings of the graduate students is acknowledged as something that can always be done better. Making progress in this direction is a partnership between the academics in the Institute and the Universities those members are appointed to, but the structure by which research programs are founded the lead proponents for any such activities are the academics themselves. The Faculty of Engineering and Design then must be supportive to those activities.

With respect to investing in lab equipment, the bulk of these financial resources will have to come from external funding sources, while the universities can contribute modest funds its role is more on finding the right kinds of space for new equipment. The current members of the joint institute, which includes several new hires who are experimentalists, have been ambitious in this regard, and to date we have been able to meet (or in the process of meeting) their space needs. The Faculty of Engineering and Design undertakes space renewal as the academics pursue their experimental needs through external funding agencies.

With respect to enhancing ties with industry and government, the Unit's response shows considerable activities in this area. The Faculty of Engineering and Design is always available to requests by academics who wish university representation in establishing external partnership.

Priority Level*	Actions to be undertaken	Assigned to	Timeline	Curriculum change?
1	Invest in research laboratory equipment	All OCIECE members K. Hinzer (Vice-Dean Research, UO) A. Girouard (Ass. Dean Res., Carleton)	Continuous process	No
1	Develop interactions with industries and government labs	All OCIECE members K Hinzer (Vice-Dean Research, UO) A. Girouard (Ass. Dean Res., Carleton) Coop offices (UO and Carleton)	Continuous process	No

Recommendation 3: Harmonisation of admission and assessment processes in the joint program.

Unit response: Reviewers' comments pointed out possible discrepancies in the way application files from graduate students are assessed and processed at the two institutions, with Carleton relying on a central admission office and uOttawa rather carrying the task in a faculty-based administrative office, which may lead to variations in the criteria considered for admission.

While the three units ensure that minimum requirements for admission in OCIECE's programs at both universities are set on the same grounds, Carleton and uOttawa are separate institutions with independent central administrations that dictate the general rules and administrative procedures that apply to their respective units and students. Each institution also defines its own admission procedures and strategic recruitment policies that influence the way students gain access to graduate programs and the number of students allowed to enter in each program. As such, a complete harmonization and integration of the admission processes is beyond the reach of OCIECE management for as much as the two independent central administrations are to decide how they want to operate and implement their own model on their respective faculties and units. There also exists some variability in the supervision capability of each unit, which depends on the major trends in research, on the number of active professors, on students' completion time, on new hiring and retirements, etc. For these reasons, the actual intake at each semester varies. As a result, and to efficiently deal with the large volume of applications for admission in our programs that are received every year, it was found that administrative procedures for admission were to better to operate locally at each institution. On the other hand, there remains some coordination between uOttawa and Carleton for the admission of ambivalent cases. Moreover, graduate applicants whose admission is declined at one institution may have their file transferred for consideration at the other institution if they wish.

OCIECE is committed to ensure fairness and equity in the assessment of applications for admission in our graduate programs independently from the institution or academic unit where applications are analyzed. Given the large volume of applications received every year by each unit, OCIECE wants to ensure that admitted graduates at both institutions meet high qualification standards and language requirements, and that they can be successful in our graduate programs. This is actively implemented and validated through graduate courses sharing, where students from uOttawa or Carleton can register to courses offered at the other institution and receive the same credits. It is also supported by forming joint thesis evaluation committees for Master's and Ph.D. students where OCIECE members from both institutions are involved in the evaluation process. On the other hand, each of the three units under the joint institute must follow the rules and procedures imposed by the central administration at their respective institution. The established dialogue must and will continue to take place between the three units, the faculties and the central administrations of uOttawa and Carleton to ensure a smooth integration and delivery of our programs, especially in relation to graduate courses offered, and for the constructive research collaboration to continue to happen between faculty members at the two universities.

Ottawa decanal response: The Unit response is complete and addresses the recommendation appropriately.

Carleton decanal response:

The Faculty of Engineering and Design agrees with the Unit's response to this recommendation.

Priority Level*	Actions to be undertaken	Assigned to	Timeline	Curriculum change?

1	Continue established dialogue between the three units and two faculties to ensure that admission procedures are compatible though independent, and that admission requirements ensure that the quality of admitted graduate students meets high standards.	J. Zhao (grad coordinator, EECS) R. Amaya (grad coordinator, DOE) A. Banihashemi(grad coordinator, SCE)	Continuous process	No
1	Continue established dialogue between the two institutions' central administrations to ensure that the general rules and admission requirements remain in equilibrium.	C. Turenne Sjolander (Vice-Provost, Grad. and Postdoc. Studies, uOttawa) P. Smith (Dean, Graduate and Postdoctoral Affairs, Carleton)	Continuous process	No

Recommendation 4: Harmonization of the financial support.

Unit response: Reviewers' comments indicated that there may be some concerns about the way financial support is made available to graduate students during their program, while recognizing that such support is also dependent on the financial resources available to the individual professors.

It is indeed a fact that financial support that can be provided to individual graduate students depends on the attraction of research grants by individual OCIECE members, which in turn depends on funding programs managed by external agencies and whose accessibility varies over time, and while the alignment between funding programs and the actual needs of academic researchers often lacks in coherence. As such it is a perpetual challenge for professors to secure research funding and match its availability with that of individual students' graduate program duration to ensure continuous financial support. OCIECE members are actively engaged in the race for funding and committed to leverage all possible opportunities, either through individual initiatives, group-based funding opportunities, or industrial-partnership oriented programs.

In addition, the central administrations of the two universities and the faculties are taking a leadership role through their respective strategic recruitment policies to attract top quality graduate students by offering first-class training possibilities in a research-oriented environment, and by offering financial support via competitive and non-competitive awards and scholarships. Recently, both universities introduced international doctoral tuition fee reduction programs for all international doctoral students to pay the same tuition fees as domestic students. The majority of Ph.D. and M.A.Sc. students also receive teaching assistantships. Those with high admission GPA are offered various forms of internal admission and merit-based scholarships that are matched with additional research assistantship support provided by their thesis supervisor based on their respective research grants. There are also a number of endowment awards that the students can compete for. At uOttawa, forms of financial support are also available specifically to individuals studying in French. Though there can remain discrepancies between the financial support of different students depending on their admission GPA and on the value of research assistantship that they receive, the two universities, as well as OCIECE members acting as thesis supervisors, are investing massively toward the well-being of graduate students so that they can fully concentrate toward their research activities and optimize their learning experience and research productivity.

Beyond internal financial support managed by the two universities, from operational funds or from research grants secured by professors, graduate students have access to a plethora of graduate scholarships offered by NSERC, OGS, FRQNT, Mitacs, and several specialized programs. The two institutions are committed to promote these programs, as much as to support and guide graduate students through their application process. Via central well-organized and committee-centered pre-selection mechanisms that ensure fairness and equity among candidates, and massive time investment from OCIECE members to mentor scholarship applications development and prepare articulated recommendation letters, graduate students are provided with all opportunities to be successful at securing part of their own financial resources through merit-based scholarship programs.

As for recommendation #3 above, Carleton and uOttawa remain separate institutions with independent central administrations that establish the general rules and investment strategies regarding the financial support that can be offered to their respective graduate students. For this reason, a complete harmonization of the financial support is beyond the reach of OCIECE management for as much as central administrations are to decide on how they want to operate and how much resources can be dedicated to internal awards and scholarships.

Ottawa decanal response: The Unit response illustrates well why we are tending towards a better harmonization of financial support yet there will always remain differences not only between the two institutions, but also between individual researchers who are members of OCIECE. This is not unique to this organization, and the competitive nature of grant and scholarship applications to tri-council and other sources remains, the objective of a more complete harmonization of financial support will remain a challenge.

Carleton decanal response:

The Faculty of Engineering and Design agrees with the Unit's response, but does want to emphasize that Carleton and UOttawa set their policies and processes associated with graduate studies to serve many joint institutes and many more graduate programs that are not joint. For example, on the cost side for the student, the two institutions have different tuition and fee structure, so having a harmonized financial support system may not be the best way to create equity. Lastly, individual graduate student support, separate from the different university structures, depends on the financial resources available to the individual supervisors and their ability to secure those external funds.

Priority Level*	Actions to be undertaken	Assigned to	Timeline	Curriculum change?
1	Pursue the development of central funding models at each institution to best support research-oriented graduate students during their program.	C. Turenne Sjolander (Vice-Provost, Grad. and Postdoc. Studies, uOttawa) P. Smith (Dean, Graduate and Postdoctoral Affairs, Carleton)	Continuous process	No
1	Reinforce the awareness of graduate students about external graduate scholarship opportunities and provide mentorship for applications development	J. Zhao (grad coordinator, EECS) R. Amaya (grad coordinator, DOE) A. Banihashemi(grad coordinator, SCE)	Fall 2022 (next schol. competition)	No

Recommendation 5: Clarifying comprehensive exams processes for students.

Unit response: Reviewers reported on some doctoral students not having a clear understanding of the requirements and process related to comprehensive Ph.D. examination, which points toward a need to revisit the process and clarify the expectations for all Ph.D. candidates.

The definition of Ph.D. comprehensive examination is only broadly defined in the academic regulations at uOttawa and Carleton. As such, there is indeed an opportunity for OCIECE to clarify the requirements, expectations, and procedure in some form of guidelines to provide a clear roadmap for our doctoral students and reduce their stress level.

At OCIECE, the concept of comprehensive exams refers to the process of validating a Ph.D. student's background in two fields of relevance to electrical and computer engineering, and most preferably in relation with the candidate's specific area of research. The goal is to ensure that the students possess a solid foundation on background knowledge from junior graduate level over which they can build their research and career. The expectations on students' performance at the comprehensive examination generally remain very realistic. Though the procedure and expectations have evolved over time, especially under the recent pressure exercised by universities at large to accelerate graduation within a set timeframe, and by the diversification of the post-graduation job market for Ph.D.'s, absolute failure at comprehensive examination only happens occasionally and in extreme cases.

At any time during the program, doctoral students who wonder about the actual expectations for comprehensive exams can and should consult their supervisor, who always remains the primary resource to reach out to. OCIECE members with doctoral supervision privileges are well-aware of the specific goals, extent, and general practice for comprehensive exams in their respective specialization area. However, and without substituting for supervisors, the availability of more specific guidelines made available to all students registered in our doctoral program would indeed be beneficial. To help address the situation, the respective graduate offices keep track of students who should take the exam at a given time in their Ph.D. program and a memo is sent ahead of time to those individuals explaining the process, timeline, and the actions that the students and their supervisors will need to take.

On the other hand, preparing a guide of practice with clear rules and expectations first requires a strong consensus to be found among the opinions of the many members of OCIECE, which is a challenge. For that matter, inspiration can be found in other faculties who have managed to set up such guidelines but for specific programs only, as well as from other engineering doctoral programs supported by similar joint institutes at uOttawa and Carleton. In the latter case, expectations for comprehensive Ph.D. examination were recently formulated with the objective to accelerate the progress of top talented doctoral students in light of a job market that now reaches far beyond the academic world. But different visions remain among our membership and must also be taken into consideration. Some emphasize the need for Ph.D. candidates to demonstrate a strong and rigorous background in a broad area of electrical and computer engineering, suited for the more traditional path toward an academic career, while others privilege a focused evaluation in a specific area of specialization related to the student's thesis work. Opinions also support a robust filtering stage for recently admitted doctoral students. Moreover, Carleton and uOttawa had come to implement slightly different practices for comprehensive examination, favoring efficiency on one hand with a narrower and predefined set of available topics to choose from and exams to be written at a specific time and only once a year; versus favoring versatility with a broad range of exam topics available among which two can be selected in closer connection with the student's research area and exams that can be written at any time of the year. The latter considerations relate also to the independent administrative structures of the two institutions that support the execution of comprehensive exams and to some extent govern the process.

Ottawa decanal response: I agree with the Unit response and notably with the suggested actions to be undertaken to improve the situation within the constraints that have been described.

Carleton decanal response:

The Faculty of Engineering and Design agrees with the Unit's response to this recommendation, though we encourage departments and institutes to consider the development of a program handbook to pull together the materials that are core elements of process through all stages of the graduate students' progression through their program.

Priority Level*	Actions to be undertaken	Assigned to	Timeline	Curriculum change?
1	Reconsider the desired objectives and execution process for comprehensive Ph.D. examination in light of alternative models recently introduced in similar programs by other engineering joint institutes and in other faculties.	P. Payeur (OCIECE director) J. Zhao (grad coordinator, EECS) R. Amaya (grad coordinator, DOE) A. Banihashemi(grad coordinator, SCE)	Fall 2022	No
1	Discuss with all three units and work toward a consensus among OCIECE members about the desired extent of comprehensive examination across all research areas of OCIECE and define the related expectations in an accessible and realistic manner.	All OCIECE members via J. Zhao (grad coordinator, EECS) R. Amaya (grad coordinator, DOE) A. Banihashemi(grad coordinator, SCE)	Winter 2023	No
1	Document and communicate the nature of the comprehensive examination process with clear procedure and general expectations to OCIECE doctoral students at the time of entry in the program.	P. Payeur (OCIECE director) R. Amaya (OCIECE associate director)	Spring 2023	No

* PRIORITY LEVEL: 1. URGENT-IMMEDIATE ACTION REQUIRED 2. IMPORTANT-ACTION REQUIRED WITHIN 18 MONTHS (MAXIMUM) 3. ADVISED: DEVELOPMENT AND STRATEGY-ACTION TO BE DISCUSSED AND MUST BE IN PLACE BY MID-CYCLE (WITHIN 4 YEARS)