Carleton University

Office of the Vice-Provost and Associate Vice-President (Academic)

memorandum

DATE: January 13, 2023

TO: Senate

FROM: Dr. Dwight Deugo, Vice-Provost and Associate Vice-President (Academic), and Chair, Senate Quality Assurance and Planning Committee

RE: Final Assessment Reports and Executive Summaries

The purpose of this memorandum is to request that Senate approve the Final Assessment Reports and Executive Summaries arising from cyclical program reviews. The request to Senate is based on recommendations from the Senate Quality Assurance and Planning Committee (SQAPC).

The Final Assessment Reports and Executive Summaries are provided pursuant to article 5.4.1. of the provincial Quality Assurance Framework and article 7.2.24 of Carleton's Institutional Quality Assurance Process (IQAP). Article 7.2.24.3 of Carleton's IQAP (passed by Senate in November 2021 and ratified by the Ontario Universities Council on Quality Assurance in April 2022) stipulates that, in approving Final Assessment Reports and Executive Summaries 'the role of SQAPC and Senate is to ensure that due process has been followed and that the conclusions and recommendations contained in the Final Assessment Report and Executive Summary are reasonable in terms of the documentation on which they are based.'

In making their recommendations to Senate and fulfilling their responsibilities under the IQAP, members of SQAPC were provided with all the appendices listed on page 2 of the Final Assessment Reports and Executive Summaries. These appendices constitute the basis for reviewing the process that was followed and assessing the appropriateness of the outcomes.

These appendices are not therefore included with the documentation for Senate. They can, however, be made available to Senators should they so wish.

Any major modifications described in the Implementation Plans, contained within the Final Assessment Reports, are subject to approval by the Senate Committee on Curriculum, Admission, and Studies Policy, the Senate Quality Assurance and Planning Committee (SQAPC) and Senate as outlined in articles 7.4.1 and 5.1 of Carleton's IQAP.

Once approved by Senate, the Final Assessment Reports, Executive Summaries and Implementation Plans will be forwarded to the Ontario Universities' Council on Quality Assurance and reported to Carleton's Board of Governors for information. The Executive Summaries and Implementation Plans will be posted on the website of Carleton University's Office of the Vice-Provost and Associate Vice-President (Academic), as required by the provincial Quality Assurance Framework and Carleton's IQAP.

Omnibus Motion

In order to expedite business with the multiple Final Assessment Reports and Executive Summaries that are subject to Senate approval at this meeting, the following omnibus motion will be moved.

Senators may wish to identify any of the following 2 Final Assessment Reports and Executive Summaries that they feel warrant individual discussion, that will then not be covered by the omnibus motion. Independent motions as set out below will nonetheless be written into the Senate minutes for those Final Assessment Reports and Executive Summaries that Senators agree can be covered by the omnibus motion.

THAT Senate approve the Final Assessment Reports and Executive Summaries arising from the Cyclical Reviews of the programs.

Final Assessment Reports and Executive Summaries

1. **Undergraduate Programs in Physics**
   SQAPC approval: January 12, 2023

SQAPC Motion:
THAT SQAPC recommends to SENATE the approval of the Final Assessment Report and Executive Summary arising from the cyclical program review of the Undergraduate programs in Physics.

Senate Motion January 27, 2023:

THAT Senate approve the Final Assessment Report and Executive Summary arising from the Cyclical Review of the Undergraduate programs in Physics.

2. **Undergraduate programs in Biomedical and Electrical Engineering; Communications Engineering, Computer Systems Engineering and Software Engineering**
   SQAPC approval: January 12, 2023

SQAPC Motion:
THAT SQAPC recommends to SENATE the approval of the Final Assessment Report and Executive Summary arising from the cyclical program review of the Undergraduate programs in Biomedical and Electrical Engineering; Communications Engineering, Computer Systems Engineering and Software Engineering.

Senate Motion January 27, 2023:

THAT Senate approve the Final Assessment Report and Executive Summary arising from the Cyclical Review of the Undergraduate programs in Biomedical and Electrical Engineering; Communications Engineering, Computer Systems Engineering and Software Engineering.

CARLETON UNIVERSITY COMMITTEE ON QUALITY ASSURANCE
Cyclical Review of the undergraduate programs in Physics
Executive Summary and Final Assessment Report

This Executive Summary and Final Assessment Report of the cyclical review of Carleton's undergraduate programs in Physics are provided pursuant to the provincial Quality Assurance Framework and Carleton's Institutional Quality Assurance Process (IQAP).

EXECUTIVE SUMMARY

The undergraduate programs in Physics reside in the Department of Physics, a unit administered by the Faculty of Science.

As a consequence of the review, the programs were categorized by Carleton University's Senate Quality Assurance and Planning Committee (SQAPC) as being of good quality. (Carleton's IQAP 7.2.13-7.2.14).

The External Reviewers' report offered a very positive assessment of the programs. Within the context of this positive assessment, the report nonetheless made a number of recommendations for the continuing enhancement of the programs. These recommendations were productively addressed by the Chair of the Department of Physics, the Dean of the Faculty of Science in a response to the External Reviewers' report and Implementation on Plan that was submitted to SQAPC on October 27, 2022.

FINAL ASSESSMENT REPORT

Introduction

The undergraduate programs in Physics reside in the Department of Physics, a unit administered by the Faculty of Science. This review was conducted pursuant to the Quality Assurance Framework and Carleton's Institutional Quality Assurance Process (IQAP). As a consequence of the review, the programs were categorized by Carleton University's Senate Quality Assurance and Planning Committee (SQAPC) as being of good quality. (Carleton's IQAP 7.2.13-14).

The virtual site visit, which took place between March 28-30, 2022, was conducted by Dr. Bob Kowalewski from University of Victoria, and Dr. Stefi Baum from University of Winnipeg. The site visit involved formal meetings with the Vice-Provost and Associate Vice-President (Academic), the Provost, the Dean of the Faculty of Science, and the Chair of the Department of Physics. The review committee also met with faculty members, staff, and undergraduate students.

The External Reviewers' report, submitted on April 19, 2022, offered a very positive assessment of the program.

This Final Assessment Report provides a summary of:

- Strengths of the programs
- Challenges faced by the programs
- Opportunities for program improvement and enhancement
- The Outcome of the Review
- The Implementation Plan

This report draws on five documents:

- The Self-study developed by members of the Department of Physics (Appendix A)
- The Report of the External Review Committee (Appendix B).
- The response and implementation plan from the Chair of the Department of Physics (Appendix C)
- The Response from the Dean of the Faculty of Science (Appendix D).
- The internal discussant's recommendation report (Appendix E).

Appendix F contains brief biographies of the members of the External Review Committee.

This Final Assessment Report contains the Implementation Plan (Appendix C) developed by the Chair of the Department of Physics and agreed to by the Dean of the Faculty of Science for the implementation of recommendations for program enhancement identified as part of the cyclical program review process.

The Implementation Plan identifies who is responsible for implementing the agreed upon recommendations, as well as the timelines for implementation and reporting.

Strengths of the programs

General

The External Reviewers' Report states that "the Carleton University undergraduate physics programs are of very high quality and feature strong, well designed theoretical and experimental components. The Honours programs allow students to focus on experimental, theoretical or astrophysics streams. In addition, double/combined Honours programs with Mathematics, Chemistry and Biology allow for a deep educational experience in multiple areas. The department also serves a sizable cohort of Engineering Physics students."

Faculty

Speaking with regard to faculty, the external reviewers' stated:

"The department has high profile in two research areas, particle physics and medical physics, accompanied by a strong graduate program, which provides excellent opportunities for undergraduate engagement in research and has a salutory influence on undergraduate pedagogy. These strengths have been reinforced by an impressive cohort of recent faculty hires in these areas. This research focus underpins the quality and reputation of the undergraduate programs, particularly the Honours streams, the strength of which are evidenced by the acceptance of Honours physics graduates into top-tier physics graduate schools and by their subsequent success."

Curriculum

The external reviewers noted that "the structure of the undergraduate physics programs is sound. This is evidenced by the well conceived program-level learning goals and the detailed mapping (which we applaud) of these goals to both provincial degree-level expectations and to the undergraduate physics curriculum. A notable strength is the experimental and experiential physics education they provide, which is underpinned by a strong and well maintained undergraduate laboratory program with good technical and pedagogical staff support. Crafting an appropriate physics curriculum is not an easy task. Physics education relies on a strong mathematical and computational background as well as an understanding of sometimes counterintuitive concepts that must be internalized over time. It builds hierarchical knowledge and experimental capacity in students. Successful outcomes require a continuous balancing of program components and an ongoing assessment of incoming student readiness and post-graduation outcomes."

Opportunities for program improvement and enhancement

The External Reviewers' Report made 14 recommendations for improvement:

1. The unit systematically gather data on student outcomes.

2. Provide common space for physics undergraduate study and cohort development.

3. Support the observatory and astrophysics labs.

4. Prior to pursuing a 15-credit degree program, articulate clearly its value.

5. Introduce computational training early and reinforce it throughout the program.

6. Regularly assess the mathematical and computational preparedness of incoming students.

7. Create a long-term plan for laboratory upgrades and renovations.

8. Provide more administrative support for faculty research.

9. Update the departmental strategic plan.

10. Support teaching and Honours project supervision in the astrophysics stream.

11. Build and brand the Major programs around recognizable goals that are distinct from those of the Honours programs.

12. Create or update a faculty hiring plan.

13. Consider carefully the benefits, costs and compromises associated with hybrid learning formats.

14. Create and/or make use of internal grant programs.

The Outcome of the Review

As a consequence of the review, the undergraduate programs in Physics were categorized by Carleton University's Senate Quality Assurance and Planning Committee (SQAPC) as being of **GOOD QUALITY** (Carleton's IQAP 7.2.13-14).

The Implementation Plan

The recommendations that were put forward as a result of the review process were productively addressed by the Chair of the Department of Physics and the Dean of the Faculty of Science in a response to the External Reviewers' report and Implementation Plan that was considered by SQAPC on October 27, 2022. The Department agreed unconditionally to recommendations #7, 9, 12, and 13; agreed to recommendations #1, 2, 3, 5, 6, 8, 10, and 14 if resources permit; and agreed in principle to recommendations 4 and 11.

It is to be noted that Carleton's IQAP provides for the monitoring of implementation plans. A monitoring report is to be submitted by the academic unit and Faculty Dean, and forwarded to SQAPC for its review by June 30th, 2025.

The Next Cyclical Review

The next cyclical review of the undergraduate programs in Physics will be conducted during the 2027-28 academic year.

Physics
Unit Response to External Reviewers' Report & Implementation Plan
Programs Being Reviewed: Undergraduate Programs

Note: This document is forwarded to Senate, the Quality Council and posted on the Vice- Provost's external website.

Introduction & General Comments

Please include any general comments regarding the External Reviewers' Report.

The Physics Department was pleased to receive the Reviewers' very positive External Reviewers' report on April 26. We are committed to the continual improvement of our programs to enhance the student, staff, and faculty experience. This document contains both a response to the External Reviewers' Report and an Implementation Plan (Section B) which have been created in consultation with the Dean(s).

For each recommendation ***one*** of the following responses must be selected:

Agreed to unconditionally: used when the unit agrees to and is able to take action on the recommendation without further consultation with any other parties internal or external to the unit.
Agreed to **if additional resources permit:** used when the unit agrees with the recommendation, however action can only be taken if additional resources are made available. Units must describe the resources needed to implement the recommendation and provide an explanation demonstrating how they plan to obtain those resources. In these cases, discussions with the Deans will normally be required and therefore identified as an action item.
Agreed to in principle: used when the unit agrees with the recommendation, however action is dependent on something other than resources. Units must describe these dependencies and determine what actions, if any, will be taken.
Not agreed to: used when the unit does not agree with the recommendation and therefore will not be taking further action. A rationale must be provided to indicate why the unit does not agree (no action should be associated with this response).

Calendar Changes

If any of the action items you intend to implement will result in calendar changes, please describe what those changes will be. To submit a formal calendar change, please do so using the Courseleaf system.

Hiring

Where an action item requires additional hiring (faculty or staff) the owner should at minimum include the Dean of the faculty and member of the unit.

UNIT RESPONSE AND IMPLEMENTATION PLAN **Programs Being Reviewed:** **Prepared by (name/position/unit):**					
External Reviewer Recommendation & Categorization	**Unit Response (choose only one for each recommendation):** **1- Agreed to unconditionally** **2- Agreed to if additional resources permit (describe resources)** **3- Agreed to in principle** **4- Not agreed to** **Rationales are required for categories 2, 3 & 4**	**Action Item**	**Owner**	**Timeline**	**Will the action described require calendar changes? (Y or N)**
[Weakness] Systematically gather data on student outcomes. In reading the self-study we noticed that data on outcomes were largely absent, and in the virtual site visit we confirmed that data on outcomes is not available (apart from the NSSE survey and anecdotal reports). While this problem is not uncommon in Canadian physics programs, it impedes efforts to gauge quality and inform planning. For example, as the forefront of research changes and as the capabilities in demand by potential employers evolve, programs also need to evolve; data on outcomes is needed to inform this evolution. We recommend that the Department (or Faculty) institute better ways to track overall outcomes. It may be more efficient to implement this tracking at the Faculty of Science level. Among the approaches that could be considered are (1) improved tracking of alumni with regular surveys (perhaps every five years) of their career paths and how well their educational programs prepared them, (2) regular interactions	*2* *We agree that having data on student outcomes would be useful for planning. Help from various university offices, such as University Advancement and the COOP office would be useful to collect this data.*	*At the Departmental level we propose to explore various options:* - *Conduct an exit survey for our graduates* - *Collect contact info of our graduates* - *Create a LinkedIn account for the department, to connect with Alumni* - *Coordinate with the Faculty or the Advancement office to survey our Alumni.*	*Physics Department*	*2022-2023 academic year*	*N*

with employers of coop students concerning the preparation and capabilities of the students, (3) regular interactions with Major employment sectors of graduates concerning the same. The widespread use of social media such as LinkedIn may offer a cost-effective means of gathering these data.					
[Weakness] Provide common space for physics undergraduate study and cohort development. Since we were unable to tour the facilities in person, it was difficult for us to adequately assess the spaces available to the department for offices, labs, teaching, and help centres. However, the department clearly lacks dedicated space for interaction, study and cohort development for physics undergraduates. This kind of dedicated space can have a significant positive impact on student outcomes, and this need is pressing given the return of students and in-person instruction to campus. An open-plan space of adequate size (not small office) would be ideal for this purpose. Adequate space for graduate students is also essential, since a vibrant graduate program has highly beneficial impact on the undergraduate physics cohort. Insufficient graduate student space has a negative impact on undergraduate programs, as graduate students work as teaching assistants and frequently are work with undergraduate researchers as well.	*2* *We agree with the External Reviewers that having a physical space were undergraduate students can interact would be very useful to create a sense of community within the department. This has been a wish of the department for a number of years, unfortunately we could never secure an appropriate space due to a general lack of space at University and Faculty levels.*	- *We will continue to discuss with the Faculty to find an appropriate space*	*Physics Departmentt/Dean of Science*	*2022-2023*	*N*

[Concern] Support the observatory and astrophysics labs. The astrophysics stream shows clear growth. It needs solid support for the facilities (observatory and associated lab support) crucial for experiential learning. The hiring of a technical staff member or instructor with responsibilities for the observatory to support this area should be prioritized.	*2* *The observatory plays an important role for our Astrophysics stream and is used for popular outreach activities. In the past, activities related to the observatory were organized by a laboratory superintendent that since left the department. Currently, one of our graduate students plays this role. Having a staff member with responsibilities related to the observatory would provide a longer-term solution and would allow us to expand the activities of the observatory.*	- *The Department will look for opportunities to hire a staff member (for a current or new position) that has the required knowledge or experience to manage the operations of the observatory.*	*Physics Department/Dean of Science*	*2-3 years*	*N*
[Concern] Prior to pursuing a 15-credit degree program, articulate clearly its value. We were asked to comment on the idea of a 15-credit program in physics. At this stage the value of such a degree program has not been clearly articulated. It should *not* be defined as a fall-back option for students who are either unable to, or who decide they no longer wish to, complete an Honours or Major program. Before introducing such a program, a clear articulation of the likely or possible career paths of program graduates should be made, a realistic estimate of potential enrolments should be produced, and a process for following the career outcomes of these graduates should be envisioned. If such a program is implemented, the department will need to assure that adequate prerequisite requirements are in place so as to maintain the level of upper-division physics courses.	*3* *The Department, working with the Dean's office and Provost's office, has developed a 15-credit program. This program can allow incoming students with specific career goals to have a shorter path to achieving them. For example, students planning to teach at a high school level can enter Teacher's College in Ontario with a 15-credit degree. As another example, students aiming at a science communications type of career could benefit from a flexible and shorter degree pathway.* *It is also true that the program could facilitate completion of degrees by students who might otherwise not realistically be capable of doing so. The Dean's office has evaluated this aspect of the proposed program and has strongly encouraged its creation.*	*- monitor enrolment and potential effects on resources and other programs*	*Physics Department*	*2023-2024*	*Y*

	Enrolment is not expected to be particularly significant for this program compared to other Physics programs and, as such, it is not expected to require any significant changes to resource allocations. Moreover, the quality and delivery of all existing courses for the 20-credit programs will not change. This will be emphasized to the Department and monitored. *The Department values the feedback from the reviewers on this topic and, although creation of the 15-credit program will go forward, the concerns of the reviewers will be kept in mind and the effects (and effectiveness) of this program will be monitored carefully.*				
[Concern] Introduce computational training early and reinforce it throughout the program. We recommend that the department consider a more structured development of computational fluency in their students, as these skills are both essential in physics and broadly applicable outside of it. Such a structure would incorporate computational training in courses and labs early in the program and build these skills by threading computational components throughout the program. The implementation of this strategy may benefit from upgrading the computational teaching lab and from the selection of one main computing platform to ensure a minimum competency level. There may be scope for collaborating with other Science departments in this effort, e.g., having a software development position at the Faculty level to support integration	*2* *The Department is committed to developing the computational expertise of its students. It is clear that the computational skills of scientists and industry professionals alike are required to be at a higher level than ever before. The Department recognizes that its programs can benefit from a detailed review of the computational components and progression for undergraduate students. The Curriculum Committee will carry out this exercise with the goal of ensuring that appropriate levels of computational training are being provided at each stage of an undergraduate student's program. The Committee will evaluate the possibility of enhancing the computational elements in existing courses and also the possible*	*- evaluate current computational content in existing courses* *- consider developing a new (likely 2nd year) dedicated computational course*	*Physics Department*	*2022-2023*	*Y*

of computational tools in undergraduate (and graduate) education.	*creation of a new, computational focused course at the 2nd year level.* *One challenge often encountered when wanting to incorporate more significant computational elements into a course is the need for expert support in developing the hardware and/or software tools required. Having access to dedicated support person could obviate this difficulty.*				
[Concern] Regularly assess the mathematical and computational preparedness of incoming students. An ongoing concern for all university educational programs that require a strong foundation in mathematics is the preparation of incoming high school graduates. The general trend has been toward lower mathematical competency, on average, for incoming students. Mathematical competency is critical for the attainment of a physics degree. Thus the adequacy of the mathematical, computational, and statistical education provided as part of the Major and Honours degrees becomes increasingly important. It is well understood that lack of adequate mathematical and computational capability can create a barrier to success in STEM fields. Helping students translate understanding from one field (e.g., mathematics) to application in another (e.g., solving of physics problems) is universally acknowledged to be a very difficult problem that can only be addressed by repeated exposure and by building capacity in students through application. We recommend that the department	*2* *The mathematical preparedness of incoming students has been a concern of the department for some time. Some resources exist to better prepare students for University level mathematics or help current students who struggle with math. For example, the Science Student Success Centre offers mentoring and the Peer Assisted Study Sessions allow students to attend weekly workshop and office hours. Finally, each summer there is a program called Math Matters that helps incoming students get up to speed on math topics they will need in their degree. This is a program that we always advertise this program to our incoming class.* *The Department could also explore the possibility of developing new resources tailored to physics students.*	- *Work with course instructors to make sure important math topics are taught in some depth in physics courses.* - *Explore the possibility of establishing our own preparation course, inspired by the Math matters program (Chem Matters and Comp Matters also exist).* - *Explore the possibility of giving a placement test to incoming students to identify weaknesses*	*Physics Department*	*2022-2023*	*N*

regularly assess the mathematical and computational capacity of incoming students (is there a non-binding mathematics placement test conducted for incoming students, or on a regular basis?) and design an approach that assures adequate mathematical and statistical understanding in students as they progress through the program, so they do not enter a course unprepared. We encourage the opening of well coordinated combined physics/math/computation help centres where students can go for regular assistance with problem solving, the building of their understanding and its application to complex topics.					
[Concern] Create a long-term plan for laboratory upgrades and renovations The laboratory staff are to be congratulated on their dedication and flexibility in responding to the restrictions imposed by public health authorities on in-person learning. Our virtual tour of the laboratories showed clean, well organized spaces with a 'vintage' look. This is not necessarily a negative, but we recommend that a long-term plan for equipment upgrades and laboratory renovations be put in place to ensure that students gain experience during their education with environments and instrumentation similar to what they will use in post-graduation employment or graduate research.	*1* *We agree that it is essential to keep the laboratories functional and up to date with current technology and ideally relevant to future employment.* *Every year, as part of the budget submission to the Dean, the Scientific Officer prepares a list of laboratory equipment that need to be upgraded or replaced. The list classifies the different elements according to the urgency in replacing them. We will keep working with the Scientific Officer to make this plan more detailed and longer term.*	- *Based on the budget submission, create a long-range plan of laboratory upgrades and renewal.*	*Physics Department*	*2022-2023*	*N*

[Opportunity] Provide more administrative support for faculty research Faculty time is an essential and limited commodity. With the increase in funded research, it becomes critical to increase the administrative support for faculty research; otherwise all faculty activities suffer. This administrative support would also benefit the undergraduate program directly by facilitating the pursuit of both internal and external funds to support UG student research.	*2* *The combination of Departmental, University, and research administrative loads on faculty members often restricts contributions in other areas. For example, decisions on whether to take on undergraduate students (and graduate students) for research, participation in university committees, course creation and development, generating funding applications etc are directly affected by considerations of administrative loads. Additional administrative support, particularly towards research, would directly enhance the Department's ability to deliver and enhance undergraduate programs and research efforts. An additional administrative position could help, for example, in managing travel, expenses and HQP salaries for group with large, multi-PI grants, help with organization of conferences and workshop, help with communication (website, social media) and help with the administration of the CAMPEP medical physics program.*	- *Explore with the Dean of Science the possibility of adding an administrative position for the department.*	*Physics Department/Dean of Science*	*2022-2023*	*N*
[Opportunity] Update the departmental strategic plan. We understand that it has been some time since the last strategic planning exercise took place. The updated plan should account for changed realities, internal and external.	*1* *We agree, this is overdue.*	- *Work on the new departmental long-range plan will begin in the Fall of 2022.*	*Physics Department*	*2022-2023*	*N*

[Opportunity] Support teaching and Honours project supervision in the astrophysics stream. The department needs to ensure that the teaching and research project supervision for this growing stream are adequately resourced. This could be accomplished through the hiring of one or two tenure-stream faculty in astrophysics and/or the active affiliation of astrophysicists and astronomers from NRC or other colleges or universities. This is vital to assure that research underpins the undergraduate educational strength for this stream as it does for the other streams offered by the department. It is very possible to hire tenure-stream faculty in astronomy and astrophysics whose research has strong connections (computation, modelling, statistical analysis, imaging, instrumentation) to particle physics and medical physics, so hiring in this area need not be a strong deviation from the current strategy of the department. The department should consider these points in their updated strategic plan.	*2* *The astrophysics stream program has become one of the most popular undergraduate programs in the Physics Department. A key requirement for all Physics honours programs is a 1.0 credit honours project normally completed during the 4th year of a student's program.* *In the past, the Department was able to provide astronomy and cosmology specific projects to undergraduate students. This was, in part, coupled to the operation of the observatory facility. Unfortunately, the key employee contributing to this chose to move on from Carleton and no current personnel have the expertise to take up this role. In addition, former links to scientists outside of Carleton who provided astrophysics-related projects have been lost (in part owing to the pandemic).* *The Department continues to explore opportunities for partnerships with outside institutions but would greatly benefit from in-house expertise to support the astrophysics program.*	- Explore possibilities for new partnerships to enhance capabilities for offering astrophysics specific honours projects	*Physics Department*	*2022-2023*	*N*
[Opportunity] Build and brand the Major programs around recognizable goals that are distinct from those of the Honours programs. The Honours programs have a well articulated goal and purpose, and outcomes are tracked through the success of students entering graduate programs and their subsequent graduate degree attainment. As noted above the Honours	*3* *We agree with the External Reviewers that offering flexibilities is desirable, and in fact the Major program does offer a lot of flexibility in term of optional courses. We also agree in principle that allowing students in the Major program with a good GPA access to honours*	. - *The curriculum committee will examine the possibility of offering to students in the Major program with good GPA the possibility of doing an honours project. The committee will need to determine whether the offering of projects by*	*Physics Department*	*2022-2023*	*N*

program at Carleton is strong, and by these metrics, achieving its intended purpose. The Major programs should address the needs of students who do not necessarily want to pursue graduate degrees in physics. They can serve a clear need by offering flexibility (which is constrained in the highly prescriptive Honours programs) to allow students to craft more personanlized educational paths. For example, some students may want a greater emphasis on computation and statistics, others may want more emphasis in policy and communication, etc. The opportunity (not requirement) for Major students to participate in capstone research projects in their final education year should be considered, as the department has the research faculty capacity for this.	*projects could be beneficial, but the ability to do so is limited by the number of projects available.*	*faculty members is sufficient to allow this option.*			
[Opportunity] Create or update a faculty hiring plan. The focus on hiring in particle physics and medical physics has served the department well, allowing it to maintain national and international prominence in these areas. However, there may be scope for providing some breadth and responding to student interest in a related area, as mentioned elsewhere in the report. Consideration should also be given to hiring full-time lecturers to reduce the dependence on contract instructors and provide enhanced quality and continuity.	*1* *We agree that maintaining an up-to-date hiring plan is necessary. Historically this has been a major focus of the departmental long-range plan and we intend to include one in the next iteration.*	- *Update the long-range plan.*	*Physics Department*	*2022-2023*	*N*

[Opportunity] Consider carefully the benefits, costs and compromises associated with hybrid learning formats. Like many universities, there is limited experience available at Carleton to date with return to in-person learning and the pros and cons of hybrid formats of education. We heard from both faculty and students a desire to return to in-person format. We share this viewpoint, which recognizes the importance of in-person interactions and collaborative problem-solving for the learning of complex mathematical and physical concepts. In-person interaction can also be vital for the learning of guided experimental techniques on dedicated equipment. We also heard about equity concerns, such as the desire to accommodate students for whom travel to campus imposes significant difficulties. The lessons from the massive experiment with remote learning remain unclear, at Carleton and elsewhere. In all likelihood, hybrid learning may play a role in some, but not all, courses and programs going forward. We recommend careful consideration and enunciation of goals and desired outcomes, and the measurement thereof, recognizing that all solutions require compromises. For instance, it may be possible to offer hybrid learning but doing so may require significant extra expenditure of time and energy to ensure that those learning in person and online have equivalent educational experiences and acquire the same level of understanding, without reducing standards. It may turn out that it is not possible to ensure that those choosing the online	*1* *We agree that remote teaching is probably here to stay, and that the department will need to adapt its offering to the new reality. In the next academic year, one lecture section for our Fall and Winter service courses will be online as well as our general interest astronomy courses (which always had a remote component).*	- *The curriculum committee will monitor and assess the outcome of our online offering and adjust it based on this assessment, the pedagogical requirements of our programs and the needs of our students.*	*Physics Department*	*2023-2024*	*N*

approach to a hybrid class will attain the same level of understanding; in that case a decision will have to be made about which way to proceed. The Department or University may find hybrid learning so important that, although it requires more time and energy to do it well, it is worth it. This means, in the absence of additional resources, that something else would need to be given up. Our recommendation is simply to think clearly about the situation and possibilities, to measure outcomes (one approach to this is to give an anonymized, annual year-end knowledge test to students with rewards for participation that is used only for assessing pedagogical outcomes) and to choose carefully the path forward.					
[Opportunity] Create and/or make use of internal grant programs. The most important commodity for departments and faculty is their time. Time is needed to improve pedagogical approaches, to consider curriculum evolution, to develop outcome-monitoring plans and follow through on them, to apply for and receive funding for undergraduate research and for Major external research funds. We recommend that the Faculty and the University institute, if they do not have them, internal grant programs that allow faculty members to apply for substantial multi-year internal grants for pedagogical improvement, and that Physics take advantage of such opportunities as they arise. For example, the faculty responsible for first year physics courses might apply for a grant to study and evolve the approach to mathematics and computational education for	*2* *Various internal grants exist at the University level. For example, the Teaching Development Grant can support Faculty, Instructors or contract instructors that want, for example, to implement new teaching strategy, re-design assessment strategies or develop new teaching and learning resources.* *Another example is the Carleton University Experiential Learning Fund that can help to increase experiential learning opportunities.* *Most of these awards are however insufficient to allow reduced teaching load.*	- *We will try to increase awareness of these grants within the department.*	*Physics Department*	*2022-2023*	*N*

first year students from varying backgrounds and consider how best to bring students to a common fluency in their understanding of physics concepts and mathematical capacity. A group of faculty at the second year level might consider the pros and cons of separating second-year laboratories from lecture classes. Another group of faculty might consider the role of hybrid classes, and conduct experiments with approaches and assessments to determine how best to proceed in the in-person environment in ways which retain the best of what we learned during the COVID-19 online experiment. The grants need to be of a sufficient size to provide some teaching release to allow faculty to invest the needed time and effort in new pedagogy development.					

CARLETON UNIVERSITY COMMITTEE ON QUALITY ASSURANCE

Cyclical Review of the undergraduate programs in Biomedical and Electrical Engineering, Communications Engineering, Computer Systems Engineering and Software Engineering

Executive Summary and Final Assessment Report

This Executive Summary and Final Assessment Report of the cyclical review of Carleton's undergraduate programs in Biomedical and Electrical Engineering, Communications Engineering, Computer Systems Engineering and Software Engineering is provided pursuant to the provincial Quality Assurance Framework and Carleton's Institutional Quality Assurance Process (IQAP).

EXECUTIVE SUMMARY

The undergraduate programs in Biomedical and Electrical Engineering, Communications Engineering, Computer Systems Engineering and Software Engineering reside in the Department of Systems and Computer Engineering, a unit administered by the Faculty of Engineering and Design.

As a consequence of the review, the programs were categorized by Carleton University's Senate Quality Assurance and Planning Committee (SQAPC) as being of good quality. (Carleton's IQAP 7.2.13-7.2.14).

The External Reviewers' report offered a very positive assessment of the programs. Within the context of this positive assessment, the report nonetheless made a number of recommendations for the continuing enhancement of the programs. These recommendations were productively addressed by the Chair of the Department of Systems and Computer Engineering, and the Dean of the Faculty of Engineering and Design responses to the External Reviewers' report and Implementation Plan that was submitted to SQAPC on November 10, 2022.

FINAL ASSESSMENT REPORT

Introduction

The undergraduate programs in Biomedical and Electrical Engineering, Communications Engineering, Computer Systems Engineering and Software Engineering reside in the Department of Systems and Computer Engineering, a unit administered by the Faculty of Engineering and Design. This review was conducted pursuant to the Quality Assurance Framework and Carleton's Institutional Quality Assurance Process (IQAP). As a consequence of the review, the program was categorized by Carleton University's Senate Quality Assurance and Planning Committee (SQAPC) as being of good quality. (Carleton's IQAP 7.2.13-14).

The site visit, which took place on October 25, 26, and 27, 2021, was conducted by Dr. Fabrice Labeau from McGill University and Dr. Anders Nygren from the University of Calgary. The site visit involved formal meetings with the Provost, the Vice-Provost and Associate Vice-President (Academic), the Dean of the Faculty of Engineering and Design, and the Chair of the Department of Systems and Computer Engineering. The review committee also met with faculty members, staff, and undergraduate students.

The External Reviewers' report was submitted on November 22, 2021, and offered a very positive assessment of the programs.

This Final Assessment Report provides a summary of:

- Strengths of the programs
- Challenges faced by the programs
- Opportunities for program improvement and enhancement
- The Outcome of the Review
- The Implementation Plan

This report draws on five documents:

- The Canadian Engineering Accreditation Board Self-study and Cyclical Program Review Volume I Supplement developed by members of the Department of Systems and Computer Engineering (Appendix A)
- The Report of the External Review Committee (Appendix B)
- The response and implementation plan from the Chair of the Department of Systems and Computer Engineering (Appendix C)
- The Response from the Dean of the Faculty of Engineering and Design (Appendix D)
- The internal discussant's recommendation report (Appendix E)

Appendix F contains brief biographies of the members of the External Review Committee.

This Final Assessment Report contains the Implementation Plan (Appendix C) developed by the Chair of the Department of Systems and Computer Engineering and agreed to by the Dean of the

Faculty of Engineering and Design, for the implementation of recommendations for program enhancement identified as part of the cyclical program review process.

The Implementation Plan identifies who is responsible for implementing the agreed-upon recommendations, as well as the timelines for implementation and reporting.

Strengths of the program

The External Reviewer's highlighted the following key strengths:

- "The department is fortunate to have highly engaged faculty members, who clearly are enthusiastic about the undergraduate programs and willing to contribute to continual program improvement. We noted a culture of collaboration, mentoring of new faculty members, and willingness to contribute to a fair distribution of the workload across the department."
- "There is strong faculty support for the Dean's priorities and strategy for expanding the faculty complement. The members of the department that we met shared an optimistic view of the future of the department and its programs."
- "Students are strongly committed to their programs and very willing to engage in continual program improvement activities. Overall satisfaction appears to be high, and students would generally recommend their programs to others. "

Opportunities for program improvement and enhancement

The External Reviewers' Report made 4 recommendations for improvement:

1. Review the role of the Program Coordinator to determine whether the scope of this role should be increased to ensure there is clearly identifiable leadership for each program. This may include formal responsibility for curriculum improvement and coordination, engagement with student leaders for ongoing feedback, planning for lab equipment needs and renewal, etc. (Concern)

2. Establish a mechanism(s) for regular feedback from students at the program level. This could involve regular meetings between student leaders and/or student "focus groups" from each program and the Program Coordinator (or alternatively, the Department Chair/Associate Chair). (Opportunity)

3. Undertake an enrolment planning exercise to determine realistic enrolment expectations for each program over the next several years. This could include undergraduate program enrolment, as well as demand for professional graduate programs (MEng) in each of the department's areas of expertise. Target future faculty recruitment to support the teaching needs identified in this enrolment plan. (Concern)

4. Explore the feasibility of other sources of teaching support for large classes, including the involvement of upper-year undergraduate students to supplement graduate teaching assistants in large classes. (Concern)

The Outcome of the Review

As a consequence of the review, the undergraduate programs in, Biomedical and Electrical Engineering, Communications Engineering, Computer Systems Engineering and Software Engineering were categorized by Carleton University's Senate Quality Assurance and Planning Committee (SQAPC) as being of **GOOD QUALITY** (Carleton's IQAP 7.2.13-14).

The Implementation Plan

The recommendations that were put forward as a result of the review process were productively addressed by the Chair of the Department of Systems and Computer Engineering, and the Dean of the Faculty of Engineering and Design in responses to the External Reviewers' report and Implementation Plan that was considered by SQAPC on November 10, 2022.

The Department:

- agreed unconditionally to recommendations #1 and #2
- agreed to recommendations #3 and #4 in principle

It is to be noted that Carleton's IQAP provides for the monitoring of implementation plans. A monitoring report is to be submitted by the academic units and Faculty Dean and forwarded to SQAPC for its review by June 30, 2024.

The Next Cyclical Review

The cyclical program review (CPR) aligns with the Canadian Engineering Accreditation Board review of the undergraduate engineering program. The Canadian Engineering Accreditation Board's review typically occurs within 1- 6 years; this time frame falls within the program's next CPR cycle. Based on this approach, the next CPR will be held by 2028/29.

Department of Systems and Computer Engineering
Unit Response to External Reviewers' Report & Implementation Plan
Programs Being Reviewed: Biomedical and Electrical Engineering, Communications Engineering, Computer Systems Engineering, Software Engineering

Note: This document is forwarded to Senate, the Quality Council and posted on the Vice- Provost's external website.

Introduction & General Comments
Please include any general comments regarding the External Reviewers' Report.

[Sample Text: The Department/School/Institute was pleased to receive the Reviewers' very positive External Reviewers' report on [date]. This report was shared with our faculty and staff, and we are committed to the continual improvement of our programs to enhance the student, staff, and faculty experience. This document contains both a response to the External Reviewers' Report and an Implementation Plan (Section B) which have been created in consultation with the Dean(s).

For each recommendation ***one*** of the following responses must be selected:

Agreed to unconditionally: used when the unit agrees to and is able to take action on the recommendation without further consultation with any other parties internal or external to the unit.
Agreed to **if additional resources permit:** used when the unit agrees with the recommendation, however action can only be taken if additional resources are made available. Units must describe the resources needed to implement the recommendation and provide an explanation demonstrating how they plan to obtain those resources. In these cases, discussions with the Deans will normally be required and therefore identified as an action item.
Agreed to in principle: used when the unit agrees with the recommendation, however action is dependent on something other than resources. Units must describe these dependencies and determine what actions, if any, will be taken.
Not agreed to: used when the unit does not agree with the recommendation and therefore will not be taking further action. A rationale must be provided to indicate why the unit does not agree (no action should be associated with this response).

Calendar Changes
If any of the action items you intend to implement will result in calendar changes, please describe what those changes will be. To submit a formal calendar change, please do so using the Courseleaf system.

UNIT RESPONSE AND IMPLEMENTATION PLAN **Programs Being Reviewed: Biomedical and Electrical Engineering, Communications Engineering, Computer Systems Engineering, Software Engineering** **Prepared by (name/position/unit): Department of Systems and Computer Engineering**					
External Reviewer Recommendation & Categorization	**Unit Response (choose only one for each recommendation):** **1- Agreed to unconditionally** **2- Agreed to if additional resources permit (describe resources)** **3- Agreed to in principle** **4- Not agreed to** **Rationales are required for categories 2, 3 & 4**	**Action Item**	**Owner**	**Timeline**	**Will the action described require calendar changes? (Y or N)**
1. Review the role of the Program Coordinator to determine whether the scope of this role should be increased to ensure there is clearly identifiable leadership for each program. This may include formal responsibility for curriculum improvement and coordination, engagement with student leaders for ongoing feedback, planning for lab equipment needs and renewal, etc. (Concern)	*1*	*The role of the program coordinator is already defined. A document better clarifying that role, including more leadership, is being drafted. The new role will be in effect starting with 2022-23 academic year.*	*Department chair*	*Spring 2022*	*N*
2. Establish a mechanism(s) for regular feedback from students at the program level. This could involve regular meetings between student leaders and/or student "focus groups" from each program and the Program Coordinator (or	*1*	*The role of the program coordinator will include engagement with the program student representative. The document clarifying the role of the program coordinator will include this task.*	*Department chair (updating program coordinator "job description")* *Program coordinator (acting on task)*	*Spring 2022* *Starting Fall 2022*	*N*

alternatively, the Department Chair/Associate Chair). (Opportunity)		*The chair already meets on a monthly basis with the department student association.*			
3. Undertake an enrolment planning exercise to determine realistic enrolment expectations for each program over the next several years. This could include undergraduate program enrolment, as well as demand for professional graduate programs (MEng) in each of the department's areas of expertise. Target future faculty recruitment to support the teaching needs identified in this enrolment plan. (Concern)	*3*	*The role of the program coordinator will include the monitoring and planning of program enrollment. The document clarifying the role of the program coordinator will include this task. Enrollment expectations are not solely the decision of the department; for instance, experience over the last 10 years shows that despite repeated requests to stabilize enrollment, the University decided to increase first year enrollment.* *The department is currently hiring for two teaching positions and two faculty positions in the two leading (in terms of enrolment) programs.*	*Department chair (updating program coordinator "job description")* *Program coordinator (acting on task)* *Faculty recruitment*	*Spring 2022* *Starting Fall 2022* *Spring and Fall 2022*	*N*
4. Explore the feasibility of other sources of teaching support for large classes, including the involvement of upper-year undergraduate students to supplement graduate teaching assistants in large classes. (Concern)	*3*	*The department already relies on upper-year undergraduate students as Teaching Assistants for early year courses. This, however, has limitations since we should not overload upper-year students at the expense of their studies* *The department started to split larger early years classes into several sections, starting Fall 2022: e.g, we are increasing the*	*Department chair*	*Fall 2022*	*N*

		number of sections for ECOR1041, ECOR1042, SYSC2006, SYSC2310, SYSC2004. Collective agreements make it very hard to investigate other kinds of involvements to provide additional support in large classes; we are considering alternatives anyway.			