**REPORT OF THE ACADEMIC PLANNING COMMITTEE**

**TO THE REGULAR April 2019 SENATE**

**QUALITY ASSURANCE - CYCLICAL PROGRAM REVIEW OF LAURENTIAN UNIVERSITY’S**

**PhD IN MATERIALS SCIENCES**

**FINAL ASSESSMENT REPORT & IMPLEMENTATION PLAN, APRIL 2019**

In accordance with the Laurentian University’s Institutional Quality Assurance Process (IQAP)**,** the Final Assessment Report has been prepared to provide a synthesis of the external evaluation and Laurentian’s response and action plan. This report identifies the significant strengths of the program, opportunities for program improvement and enhancement, and sets out and prioritizes the recommendations that have been selected for implementation.

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

**SUMMARY OF THE CYCLICAL PROGRAM REVIEW**

Materials Science is a multidisciplinary field concerned with the generation and application of the knowledge relating to the composition, structure, and processing of materials to their properties and uses.[[1]](#footnote-1) Materials can be broadly defined as any long-range atomic or molecular assemblies, which may or may not exhibit periodic ordering. Although materials are typically considered to be solids (crystalline or amorphous), other types of supramolecular assemblies (such as colloids, nano structures, self-assembled monolayers and other "soft" frameworks) also conform to this definition. Materials Science can pertain to the synthesis and investigation of bulk materials, as well as to the study of their interfacial properties and modification of their surfaces. The study of materials can be performed using both experimental and theoretical/computational approaches.

The main objective of the PhD Program in Materials Science (MTRS) is to provide coursework and research training to prepare highly qualified personnel for careers in academia or in various industrial environments.

Starting in 2010, the PhD in Materials Science has allowed students to complete their research in one of the following representative fields:

* *Structure and Properties (SP).* This field pertains to the characterization of bulk materials, including structural determination, compositional analysis and physical / chemical / thermo-mechanical property studies. This field also includes the theoretical, computational and mathematical modeling of materials with predicted properties and function.
* *Emerging Materials and Methods (EMM).* This field pertains to the synthesis of new materials, usually with properties and functions tailored for specific application goals. New methods for the preparation and the manipulation of materials are also included here.
* *Interfaces and Coatings (IC)* This field pertains to the characterization and modification of materials' surfaces. This field is separate from the other two because of the unique methods used in surface characterization, and because of the distinct nature of interfacial reactions.

This is the first IQAP review of the PhD in Materials Science.

In September 2017, the program submitted its self-study to the Office of Vice-President Academic and Provost of Laurentian University.

Part 1 of the self-study presented an overview of the program, including its learning outcomes, and then reviewed the program’s self-perception of the faculty, physical resources, students, program regulations and courses. It concluded with a section on Planning that included a discussion of program governance as well as its future goals. There were also two Appendices, A: Selected Course Outlines and B: Course Descriptions: Core and Elective Courses. which listed the various computer resources available to those in the program. Part 2 of the self-study contained the curriculum vitae of the full-time faculty in the program.

On December 2017, after reviewing the self-study, the Review Team conducted a site visit. The review committee comprised Dr. Bill Atkinson (Associate Professor, Physics & Astronomy, Trent University), Dr. Brian MacLean (Associate Professor, Chemistry, St. Francis Xavier), Dr. Mery Martinez (Biology), Dr. Hoi Cheu (English), Alexander Robillard (Graduate Student), and Emmanuel Appiah-Hagan (Graduate Student).

The reviewers met with Dr. Serge Demers (Interim VP Academic and Provost), Dr. Hélène Joly (Associate Dean, Science, Engineering and Architecture), and Dr. David Lesbarrères (Dean of Graduate Studies, by teleconference call); Tomasz Mrozewski (Library); and faculty and graduate students associated with the program.

In addition, the reviewers toured the Central Analytical Facility in the Willet Green building, as well as the Cliff Fielding Research Innovation and Engineering Building, which is currently under construction.

In their report dated 1 May 2018, the reviewers remarked that “The Materials Science program is an effective vehicle to deliver a high-quality PhD-level education. It is a young program, with opportunities to expand its student experience, research capacity, and local and national profile. MTRS faculty are engaged in the program, and the close contact between students and faculty is to be commended. Preliminary student outcomes (times-to completion, post-graduate employment) are strongly positive.” More specifically they noted:

* The MTRS program is well aligned with the university's mission and academic plans.
* The program requirements include (i) completion of three graduate-level courses, (ii) successful completion of a comprehensive exam, and (iii) defense of a research-based thesis. All three of these requirements contribute towards the learning outcomes listed in the program self-study. These learning outcomes are clearly spelled out and are consistent with the Degree Level Expectations listed in Appendix H of the IQAP guidelines.
* Admission requirements are consistent with student success in achieving the program's learning outcomes.
* Two features of the program make it unique and attractive. First is the emphasis on mining-related science…. Second is the connection to SNOLAB. SNOLAB is one of Canada's premier research facilities and has a global presence that has only grown since the awarding of the Nobel prize in physics in 2015.
* Student achievement is measured in three ways: through evaluation of coursework; through a comprehensive exam; and through a thesis defense. In general terms, these are appropriate for the stated learning outcomes and degree level expectations.
* Available outcomes measures are strongly positive:
* Of the 13 students who registered in the program, all have either graduated or remain in the program.
* Eight of the 13 students have either come with scholarships or have received scholarships during the course of their degree.
* Of the three students who have graduated, two have found careers directly related to their graduate education.
* Students are progressing through the program in a timely fashion (4 years + one semester being typical).
* Students who have completed the comprehensive examination have done so, with one exception, on their first attempt.
* Graduate student publication rates are excellent, with graduate students co-authoring approximately 40 publications over the past seven years. (We note that since it takes several years for students to become productive, the majority of these publications have appeared in the last four years.)
* The research success of the MTRS faculty is particularly impressive given the comparatively heavy teaching load of Laurentian faculty relative to larger, research-focused institutions.
* Students who were interviewed on this point were positive concerning both quality and access to supervision.
* The new Clifford Fielding building, and the centralized analytical facility it will house, is a strong step in improving the quality of all science programs at Laurentian University.

Amidst these encomiums, there were some concerns expressed about the program in the body of the report.

* The principal challenge faced by the MTRS program is its ability to deliver meaningful elective courses. This is rooted in two separate issues: First, there is a paucity of MTRS-specific courses that would allow students to acquire tools needed for their degree; second, it is difficult to staff low-enrollment graduate courses.
* The MTRS program is that it has not yet established a presence in the local industrial community. It is our understanding that existing collaborations with industry have resulted purely from initiatives taken by individual faculty members.
* The MTRS program has not used connections to SNOLAB to raise its profile at the national level.
* While student success rates are high, it is also apparent that the extreme diversity of student backgrounds makes the "general knowledge" portion of the comprehensive exam difficult to administer uniformly.
* Through conversations with graduate students and faculty, it became clear that supervisory committee meetings do not always occur at regularly scheduled intervals.
* The program is not aligned with a single department, it houses diverse research fields, and its students work in different parts of campus.
* The program has no operating budget.
* Most of the equipment in the Willet Green facility is between 25-35 years old and will eventually need replacement.
* Maintenance of research equipment in the Faculty of Science, Engineering, and Architecture is carried out by a single electronics technician. He is essential to the MTRS program, and nearly all faculty we spoke to expressed the concern that he is over-stretched.
* There does not appear to be a formal mechanism for tracking student time-to-completion, as these statistics were available only upon request.

On 24 August 2018, the program and the Dean of Science, Engineering and Architecture program submitted their comments on the Report. On 18 October 2018, the Dean of Graduate Studies submitted his which nicely summarized the Reviewers’ recommendations, the program’s reaction to those recommendations, the Dean of SEA’s comments and his own. His report report is reproduced below.

**SUMMARY OF THE REVIEW TEAM’S RECOMMENDATIONS (R) THE PROGRAM’S (P) RESPONSES AS WELL AS THOSE FROM THE DEAN OF SCIENCE, ENGINEERING AND ARCHITECTURE (D) AND THE DEAN OF THE FACULTY OF GRADUATE STUDIES (GS)**

R1: **Develop one or more MTRS Special Topics courses to meet demand for subject- specific courses.**

P: We agree with this and believe that a special topics course will offer the flexibility needed to teach subject specific courses for the Materials Science program. A new course (possibly offered by co-teaching) will be developed and submitted to the curriculum committee for approval in Fall 2018.

GS: Special topic courses are always useful at the graduate level, allowing faculty to teach within their research specialty when the demand is there. This is thus a useful addition to the course roster.

**R2: Work with the Dean's office to develop a creative solution to the problem of staffing low-enrolment graduate courses.**

P: We will work the Dean’s office to ensure staffing of low enrollment graduate courses that are essential to the success of the program. Appropriate action will be taken to ensure that students can fulfil their course requirements. Some possible solutions proposed by the faculty members of the program include:

1. Cycling of core and elective courses to minimize resource impact

2. Team teaching of the core course Advanced Materials Science (MTRS 6006)

3. Team teaching of new MTRS special topics courses

4. Expansion of the list of eligible elective graduate courses

5. Allowing MSc students in relevant disciplines to enroll in MTRS 6000 level courses

D: Team teaching of courses already exists where each professor receives partial credits for their contribution. However, receiving partial credits for low enrolment courses as suggested, would not be allowed by the Collective Agreement.

GS: In addition to opening such course to Master’s students in relevant disciplines, other PhD students (e.g. engineering, mineral exploration) could benefit from such course, thus enlarging and diversifying the pool of attendants and enriching the class discussions.

**R3: Work with the research office to raise the profile of the MTRS program within the local industrial community and to facilitate researcher-industry interactions.**

P: The program members agree that it is essential to reach out to local industry to promote research collaborations and partnerships. The program coordinator will meet with the research office to discuss the possibility of a networking event to help raise our profile within the local industrial community. We will make a concerted effort to promote both our research capabilities and the benefits of Materials Science to the community. As it has been done successfully recently, we will continue to approach local industry to secure matching funds and obtain collaborative research grants (CRD)/Engage grants from NSERC and other funding agencies for the benefit of our faculty and PhD students.

D: I fully support organizing a network event where industry personnel are invited to meet with the faculty to showcase the Program and to exchange ideas.

GS: In addition to the Research Office, conversations should be engaged with the Alumni office as to develop a network of potential industrial partners/donors.

**R4: Advertise the unique connections to industry and to SNOLAB to raise the national profile of the MTRS program.**

P: Currently, the digital footprint of the program is very weak and the information on the internet is incomplete/incorrect. We will rapidly work with computer services to correct these deficiencies and to advertise the unique aspects of the program (links with SNOLAB, Mining and Environment etc.) In addition, posters and brochures will be created, sent to other institutions and provided to faculty members to give out at conferences.

GS: Through the hiring of an MTRS graduate student, I have engaged resources to improve visibility of the faculty and the program. Additional resources will be soon available for marketing

**R5: Review the format of the comprehensive exam to allow for the diversity of student backgrounds in the MTRS program**.

P: An ad hoc committee composed of several faculty members has reviewed the current comprehensive exam structure. Several changes have been recommended and a clarified procedure that allows for the diversity of student backgrounds will be brought to the program members for approval in Fall 2018.

GS: Comprehensive exams are both an important milestone for a PhD program, and a continuous work in progress to ensure that students are examined properly in light of the current literature and their diverse background. I am thus welcoming the program in its review of the current, and first iteration of the comprehensive exam.

**R6: That a formal process be instituted whereby supervisory committees are required to submit a formal report by specified dates each year.**

P: The Faculty of Graduate Studies academic regulations state: “The committee will meet each student at least twice yearly. At this time, a short report on the student’s progress will be submitted to the Faculty of Graduate Studies by the chairs.” This rule has not been strictly enforced in the past, but we will make all efforts to ensure that this obligation is met on a going forward basis. To facilitate the process, students in the program will be responsible for calling the committee meetings and informing the coordinator of the date of completion. The coordinator will ensure that reminders are sent to the students once per semester.

GS: It is key that students and supervisors meet regularly to avoid challenges and delays to build up. If necessary, the FGS will help policing the submission of annual reports.

**R7: That the program work to enhance cohesion amongst its faculty and student members through social, networking, and academic activities.**

P: The members agree that stronger cohesion amongst the students and faculty would enhance the strength of the program. We have discussed implementing social activities such as a fall orientation BBQ and a New Year get together. However, the program currently has no budget and these types of activities require funds. Without a small reasonable budget, we will be unable to attain this goal.

D: I will request that the Program be assigned a budget to cover these important social activities. Meanwhile, I am willing to cover the cost of some of these activities through the Dean’s budget.

GS: I welcome this suggestion and the support from my colleague. If needed, I will provide additional resources for such event.

**R8: That the program be given an operating budget.**

P: This program is run through the Dean’s office and as such there is no specified budget for the program. This makes it very difficult to plan recruitment activities, social events to promote program cohesion or to bring in guest speakers from outside the University. The program coordinator will meet with the Dean of Science, Engineering and Architecture to discuss the necessity of a specific realistic budget for the program. A specific dollar value is required for planning purposes. With the status quo, it is impossible to bring guest speakers to Laurentian for the seminar program since we have no guarantee that their expenses will be covered. Having the opportunity to learn from researchers outside of Laurentian is essential to the academic development of our students. Furthermore, it provides them with new knowledge and important networking opportunities. In addition, R7 will not be successfully met without a reasonable financial commitment from the University. In the past this program did have a budget, but this was eliminated some years ago. We request that it be reinstated.

D: See response to R7.

**R9: That funds be directed towards the Willet Green facility to support equipment maintenance.**

P: Materials Science is an instrumentation intensive discipline and thus requires technical support for sample analysis and equipment maintenance. Many of the faculty members and students in this program make use of the central analytical facility solid phase section (CAF-SPS) which houses research instrumentation for materials characterization. Therefore, the program strongly supports the recommendation that funds continue to be made available for equipment maintenance. Similar arrangements should be made for access to the Perdue Central Analytical Facility opening soon on campus.

D: The Microanalytical Centre, previously known as the Central Analytical Facility, receives $15,000 annually from the Dean’s budget in addition to a contribution for sending the Research Scientist for regular training.

GS: A new Central Analytical Facility has opened in the Fall 2018 and is also offering a suite of equipment to be used by faculty and students. As a heavy user of this type of analytical equipment, I would encourage the MTRS program to make special arrangements to access the facility and possibly develop a technical course to train its students therein.

**R10: That the university ensure that sufficient technical staff are available to support existing research infrastructure in faculty labs and at the Willet Green facility.**

P: The Faculty of Science, Engineering and Architecture currently employs one electronics technician, Mr. Adam Walli, to maintain, troubleshoot and repair scientific instrumentation. This is one area where we certainly need additional resources. One electronics technician for all of the equipment in the entire faculty is clearly insufficient. In addition, it appears that Mr. Walli will also be expected to service the new Purdue Central Analytical Facility. This is an unreasonable expectation because although Mr. Walli is extremely competent and somehow always manages to get our instruments up and running he is quite literally run off his feet. It is imperative that the University hire at least one additional technician to help ease the load. This lack of resources to keep our aging infrastructure operational has a negative effect on the research productivity of our students. Properly functioning instrumentation is essential for innovative research in Materials Science.

In addition, it is imperative that a new technologist be brought in to be trained prior to Mr. Walli’s retirement. If Mr. Walli leaves, his knowledge and experience leave with him. A situation that would most certainly be detrimental to the Materials Science Program and many others.

D: The reallocation of equipment from individual research labs to the Cliff Fielding building should help lighten the load of the Faculty electronic technician. However, a succession plan for that technician should be put in place in order to guarantee the continuation of the proper maintenance of the Faculty instrumentation.

**R11: That the program implement a formal process for tracking student outcomes, including times-to-completion and post-graduate employment.**

P: The program will create voluntary exit forms for each student that will include time to completion and personal contact information so that this information can be easily tracked on a going forward basis.

GS: With 29 graduate programs and more than 200 students graduating every year, FGS cannot keep track of post-graduation career status for every student. However, we will assist with other data related to the student progress and encourage a closer relationship between the Department and the Alumni office for the former.

**ACAPLAN’S RESPONSE**

ACAPLAN endorses the recommendations of the Review Team but notes the following recommendations will not be included since they have already been acted upon:

**2.1: Cycle core and elective courses**

**2.5: Open MTRS 6000 level courses to MSc student in relevant disciplines.** It is now a policy in Graduate Studies that any graduate student can take any graduate course so long as they have the appropriate background.

**9. Fund maintenance of equipment in Willet Green.** The Dean of SEA already has a budget line dedicated to equipment in the Willet Green building.

**LAURENTIAN QUALITY ASSURANCE IMPLEMENTATION PLAN FOR THE PhD PROGRAM**

**In**

**MATERIALS SCIENCE**

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| **Recommendation** | **Proposed Follow-up** | **Responsibility for Leading Follow-up** | **Timeline** |
| 1. Develop one or more Special Topics courses | Create course and submit to CELP | Program Coordinator | June 2019 |
| 2. Implement strategies to maintain low enrolment courses | i. Team Teach core Advanced Material Science (MTRS 6006)ii. Team teach MTRS special topics coursesiii. Expand list of eligible elective graduate courses | Program Coordinator with Dean of SEA | June 2019 and ongoing |
| 3. Raise profile of MTRS program, with local industrial community | Create networking event | Program Coordinator with Research Office and possibly Alumni Office | June 2020 |
| 4. Advertise connection between SNOLAB and program[[2]](#footnote-2) | Improve website | Program Coordinator with IT unit | December 2019 |
| 5. Review format of comprehensive exam | Clarify procedure to allow fair participation from students with diverse backgrounds | Program Coordinator | June 2019 |
| 6.Ensure supervisory committees submit a formal report on each student by a specified date each year | Students required to trigger formal meeting with supervisor | Dean, Faculty of Graduate Studies | September 2019 |
| 7.Enhance cohesion among faculty and students  | Have fall orientation BBQ and New Year’s get-together funded by Dean of SEA | Program Coordinator with Dean | September 2019 and ongoing |
| 8.Establish an operating budget for program | Prepare draft budget | Program Coordinator with Dean of SEA and of FGS | June 2019 |
| 9. Support electronics technician and prepare for retirement  | Hire extra technician or at least replace existing technician upon his retirement | Dean of SEA | June 2019 |
| 10. Track student outcomes including times of completion and post-graduate employment | Create voluntary exit forms for each student to complete upon graduation | Program Coordinator | June 2019 |

The Dean of Science, Engineering and Architecture be responsible for monitoring the implementation plan. The details of progress made shall be presented in the Dean’s Annual Report and filed with the Vice-President Academic and Provost. The executive Summary and the monitoring reports will be posted on Laurentian University’s web site.

**CONCLUSION**

The PhD program in Materials Science is approved to continue and it will be reviewed in the fall of 2026.

1. *McGraw Hill Encyclopedia of Science and Technology*, 9th ed. 2002. [↑](#footnote-ref-1)
2. The Program, working with Marketing, has already created posters and brochures. This was an idea the program itself put forward in its response to the recommendation [↑](#footnote-ref-2)