FOR INFORMATION **PUBLIC** **OPEN SESSION**

TO: Committee on Academic Policy and Programs

SPONSOR: Sioban Nelson, Vice-Provost, Academic Programs
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PRESENTER: Sioban Nelson, Vice-Provost, Academic Programs
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DATE: October 22, 2013 for October 29, 2013

AGENDA ITEM: 2i

ITEM IDENTIFICATION:

Semi-Annual Report on the Reviews of Academic Units and Programs

JURISDICTIONAL INFORMATION:

"The Committee…has general responsibility…for monitoring, the quality of education and the research activities of the University. In fulfilling this responsibility, the Committee works to ensure the excellent quality of academic programs by…monitoring reviews of existing programs….The Committee receives annual reports or such more frequent regular reports as it may determine, on matters within its purview, including reports on the …[r]eviews of academic units and programs." *(AP&P Terms of Reference, Sections 3, 4.9*)

Within the *Accountability Framework for Cyclical review of Academic Programs and Units*, the role of the Committee is to undertake "a comprehensive overview of review results and administrative responses." The Committee "receive[s] semi-annual program review reports including summaries of all reviews, identifying key issues and administrative responses," which are discussed at a "dedicated program review meeting with relevant academic leadership." (*Policy for Approval and Review of Academic Programs and Units*). The Committee's role is to ensure that the reviews are conducted in line with the University's policy and guidelines; to ensure that the Provost's Office has managed the review process appropriately; to ensure that all issues relative to the quality of academic programs have been addressed or that there is a plan to address them; and to make recommendations concerning the need for a follow up report.

The compendium of review summaries is forwarded, together with the record of the Committee's discussion, to the Agenda Committee of the Academic Board, which determines whether there are any issues warranting discussion at the Board level. The same documentation is sent to the Executive Committee of the Governing Council for information.

GOVERNANCE PATH:

1. **Committee on Academic Policy and Programs (October 29, 2013)**
   + Agenda Committee of the Academic Board (November 6, 2013)
   + Academic Board (November 21, 2013)
   + Executive Committee of the Governing Council [For Information] (December 2, 2013)

PREVIOUS ACTION TAKEN:

Governing Council approved the *Policy for Approval and Review of Academic Programs and Units* in 2010. The *Policy* outlines University-wide principles for the approval of proposed new academic programs and review of existing programs and units. Its purpose is to align the University's quality assurance processes with the Province's Quality Assurance Framework through establishing the authority of the University of Toronto's Quality Assurance Process (UTQAP).

HIGHLIGHTS:

External reviews of academic programs and units are important mechanisms of accountability for the University and a vital part of the academic planning process. Academic reviews are critical to ensuring the quality of our programs through vigorous and consistent processes that assess the quality of new and existing programs and units against our international peers.

In the period between March and September 2013, since the last report to AP&P, the Office of the Vice-President and Provost received one external review of a unit, commissioned by the Dean of the Faculty of Applied Science and Engineering. The submission to AP&P includes the signed administrative response from the Dean, which highlights action plans in response to reviewer recommendations.

This review echoed common themes of previous reviews: the excellence of our faculty and students, the strength of our research reputation, and the innovativeness and quality of programs. In addition, this review highlighted the many well-structured, interactive and innovative learning opportunities available to undergraduate students; the Department's strong, highly productive research programs; and the faculty's positive morale.

As always, the review noted areas for development and made important recommendations on how these matters could be improved. The administrative response from the Dean addresses these issues and others.

Additional reviews of programs are conducted by organizations external to the University. Reviews of academic programs by external bodies form part of collegial self-regulatory systems to ensure that mutually agreed-upon threshold standards of quality are maintained in new and existing programs. A summary listing of these reviews is presented in the Appendix.

FINANCIAL IMPLICATIONS:

n/a

RECOMMENDATION:

This item is *for information and feedback only*.

DOCUMENTATION PROVIDED:

Compendium of Reviews of Academic Programs and Units

UNIVERSITY OF TORONTO

OFFICE OF THE VICE-PROVOST, ACADEMIC PROGRAMS

Reviews of Academic Programs and Units

March 2013 – September 2013

Report to the Committee on Academic Policy and Programs
October 29, 2013

Reviews of Academic Programs and Units

March 2013 – September 2013

Report to the Committee on Academic Policy and Programs

October 29, 2103

Decanal Reviews

Review Summary

Program(s):	Materials Engineering, B.A.Sc. Materials Science and Engineering, M.A.Sc. Materials Science and Engineering, M.Eng. Materials Science and Engineering, Ph.D.
Division/Unit:	Department of Materials Science and Engineering
Commissioning Officer:	Cristina Amon, Dean, Faculty of Applied Science & Engineering
Reviewers (Name, Affiliation):	1. Dr. Lorna J. Gibson, Matoula S. Salapatas Professor of Materials Science and Engineering, MIT 2. Dr. Hani Henein, Professor, Department of Chemical and Materials Engineering, University of Alberta 3. Dr. Gary R. Purdy, Professor, Materials Science and Engineering, and former Dean of Engineering, McMaster University 4. Dr. Stephen Yue, James McGill Professor and Chair, Department of Mining and Materials Engineering, McGill University
Date of review visit:	May 13 – 14, 2013

Previous Review

Date: June 26-27, 2008

Summary of Findings and Recommendations:

1. Undergraduate Program: Materials Engineering, B.A.Sc.

The reviewers observed the following strengths:

- Students enthusiastic about their program and have many opportunities for research
- Nanoscience curriculum represents an excellent future direction

The reviewers identified the following areas of concern:

- Undergraduate laboratories are strongly in need renovation to match curriculum
- Retention rates lower than Faculty average

The reviewers made the following recommendations:

- Conduct an undergraduate curriculum review
- Conduct a study related to retention

2. Graduate Programs: Materials Science and Engineering, M.A.Sc.; Materials Science and Engineering, M.Eng.; Materials Science and Engineering, Ph.D.

The reviewers observed the following strengths:

- Internationally recognized strengths in nano-materials, electronic materials and materials processing

The reviewers identified the following areas of concern:

- Education in core competencies may be lost as the study of materials science broadens

The reviewers made the following recommendations:

- Enhance communication of programmatic strengths
- Develop a set of core courses or qualifying exams in core topics

3. Faculty/Research

The reviewers observed the following strengths:

- One of Canada's leading programs in Materials Science
- Academic staff are dedicated to undergraduate teaching

The reviewers identified the following areas of concern:

- Gender and cultural diversity are limited

The reviewers made the following recommendations:

- Restructure curriculum so that faculty can increase research productivity
- Consider gender, cultural diversity, and diversity of intellectual thought in new faculty hires

4. Administration

The reviewers made the following recommendations:

- Update facilities to support teaching and research
- Develop a new strategic plan to define areas of excellence, distinguish the Department from other Materials departments internationally, and clarify undergraduate and graduate teaching

Last OCGS Review(s) Date(s): 2007/08

Current Review: Documentation & Consultation

Documentation Provided to Reviewers:

Self-Study; 2008 Review Committee Report; Department Strategic Plan; Department Faculty CVs; FASE Annual report; FASE Five-Year Academic Plan; University of Toronto Quality Assurance Process (UTQAP); excerpts from graduate and undergraduate calendars.

Consultation Process:

The reviewers met with the Dean; Vice-Dean, Undergraduate Programs; Department Chair; Associate Chair, Undergraduate Studies; Associate Chair, Graduate Studies; Advisory Committee on the Appointment of Chair; faculty, administrative and technical staff; and a small group of undergraduate and graduate students.

Current Review: Findings & Recommendations

1 Undergraduate Program

Materials Engineering, B.A.Sc.

The reviewers observed the following strengths:

- Overall quality
  - Program attracts high quality students
- Curriculum and program delivery
  - Well-structured and effective first year courses using innovative teaching techniques
  - "Highly successful" use of Portable Tabletop Labs
  - PEY program, with placements in a broad range of materials and engineering companies
  - Student access to study abroad opportunities
- Quality indicators
  - Students generally satisfied with the program and the quality of teaching

The reviewers identified the following areas of concern:

- Curriculum and program delivery
  - Department devotes considerable resources to teaching high-enrolment service courses for other programs
  - Students would like more instruction in practical applications
  - Students are concerned about post-graduation opportunities and the level of career advice that they receive
  - High undergraduate teaching loads translate into a limited number of specialized graduate courses

The reviewers made the following recommendations:

- Curriculum and program delivery
  - Develop a curriculum reform plan which streamlines offerings; reorders fundamentals and electives; coordinates clusters of subjects; eliminates certain "quarter" courses; and makes the thesis optional, reducing undergraduate teaching load
  - Consider the future of the Nanoengineering major in Engineering Science, which could include establishing an optional track for Computational Materials Science instead of Nanoengineering
  - Enhance focus on practical applications instruction in concert with the Department of Mathematics
  - Promote and enhance study abroad opportunities and career resources available to students
  - Encourage students to participate in professional societies

2 Graduate Program

Materials Science and Engineering, M.A.Sc.
Materials Science and Engineering, M.Eng.
Materials Science and Engineering, Ph.D.

The reviewers observed the following strengths:

- Quality indicators
  - High level of student satisfaction with programs and supervision

The reviewers identified the following areas of concern:

- Curriculum and program delivery
  - Graduate students noted difficulty accessing specialized courses at the appropriate stages during the program
  - Previous review recommendation regarding development of core courses still needs to be addressed
- Quality indicators
  - Exit survey results reveal “small but significant” dissatisfaction among graduates
- Enrolment
  - The additional, high cost of supporting international graduate students internally is a disincentive to admissions
  - The differential cost of international graduate students could diminish quality and diversity in the student body

The reviewers made the following recommendations:

- Curriculum and program delivery
  - Develop a core set of regularly-offered graduate courses and offer specialized courses in alternating years, improving the graduate experience and evening the faculty teaching load
  - Collaborate with other universities and offer reading courses to further increase the number of specialized courses offered
- Quality indicators
  - Determine the cause of graduate dissatisfaction
- Enrolment
  - Address the issue of funding for international graduate students, possibly through endowed scholarships

3 Faculty/Research

The reviewers observed the following strengths:

- Research

  - Strong, highly productive research with vibrant, diverse programs, including nano, bio and electronic materials
  - Recognized strengths in advanced materials
- Level of activity relative to national and international comparators
  - Success in obtaining funding for both research and infrastructure
  - Sustained interaction with industry
  - "Commendable" number of NSERC Strategic Grants awarded to faculty
- Faculty
  - Assistant professors are pleased with the resources available to them and expectations of service work
  - Hire in Process Metallurgy will renew research in this area and provide avenues to connect with industry

The reviewers identified the following areas of concern:

- Research facilities
  - Space issues impede the experimental research programs of new faculty
- Complement
  - The 49% cross-appointments in MSE disadvantage the Department relative to student registration and have implications regarding overhead costs and space
  - Concern whether planned hire in process metallurgy will produce an anticipated increase in enrolment

The reviewers made the following recommendations:

- Level of activity relative to national and international comparators
  - Direct more efforts to sustaining relationships with industry via NSERC C&D and IRC grants given the Department's increased focused on energy and sustainability
- Faculty
  - Introduce a mentoring process for new professors relative to grants, the path to promotion, etc.
- Complement
  - Increase the research credits allocated to MSE via cross-appointment collaborations
  - Make junior faculty hires to address faculty balance
  - Increase the complement of computational materials professors
  - Strengthen the recognition of diversity in hiring

4 Administration

The reviewers observed the following strengths:

- Morale of faculty, students and staff
  - "Well-grounded" faculty with high morale
  - Positive morale in the Department attests to the efforts of the chair
- Resource allocation

  - The recently-obtained research and industrial funding in support of research and undergraduate teaching
  - Computational resource needs are met
- Staff
  - Administrative staff are “very efficient, collegial and seem well connected to the undergraduate and graduate students’ needs”
  - Administrative staff support faculty in accounting and administrative functions, and faculty appreciate their efforts
  - Technical staff are “professional and very knowledgeable”
- Department/unit/programs relative to the best in Canada/North America and internationally
  - Department is strong and highly successful

The reviewers identified the following areas of concern:

- Resource allocation
  - Though well-maintained, undergraduate laboratory space is limited, reducing the possibility for hands-on learning
- Management and leadership
  - The ability to implement change is hindered by “one-man committees”

The reviewers made the following recommendations:

- Relationships
  - Strengthen relationships with other universities, industries, professional societies and alumni
  - Ensure enhanced visibility of visiting lectures and technical seminars
- Resource allocation
  - Address space allocation issues
- Management and leadership
  - Establish committees of active faculty members to consider changes in the programs

ADMINISTRATIVE RESPONSE – Appended

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

Cristina Amon, Dean

September 19, 2013

Professor Sioban Nelson
Vice-Provost, Academic Programs
University of Toronto
27 King's College Circle

Dear Professor Nelson

I write in response to Professor Regehr's letter of August 26, 2013 regarding the spring 2013 External Review of the Department of Materials Science and Engineering (MSE) and its undergraduate (Materials Engineering, B.A.Sc.) and graduate programs (Materials Science and Engineering, M.A.Sc., M.Eng., and Ph.D.). The external review process is a valuable exercise that affords us the opportunity to take stock of the state of our academic units and of the Faculty as a whole. We were pleased with the positive nature of the reviewers' report, particularly with regard to the innovative learning opportunities that have been developed for our undergraduate programs as was noted.

The following is in response to the issues raised by the reviewers in their report. For ease of reading, a summary of each area identified in the review (in bold) is followed by the administrative response.

CURRICULUM & PROGRAM DELIVERY

The reviewers emphasized the need for undergraduate curriculum reform to both streamline offerings and better position courses within the programs.

Over the last two years, the MSE department's Associate Chair Undergraduate has been working with a student task force to map content in each of the existing courses in order to determine which knowledge is core to the program, and where there are overlaps and gaps in the material delivered. In addition, MSE's undergraduate programs were reviewed by the Canadian Engineering Accreditation Board in 2012. The preparation for that review, which included a newly required assessment of graduate attributes, was helpful in assessing the undergraduate program as a whole. The MSE curriculum committee is now working on a plan to carry forward a comprehensive review of the undergraduate curriculum.

In addition, in order to address the issue of service course teaching in first year, the MSE department has started an initiative (Materials One) to modularize and standardize the materials-related content currently delivered as three courses taught to different audiences: MSE101, APS104, and MSE 160. Standardizing content and providing other supporting material

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online will allow faculty to teach first year with greater ease. Standardization will also allow our Faculty to consider whether to merge some of these courses in the future. This project will run over the next three years.

Short term goals (within the next year):

- The curriculum committee will complete its content mapping exercise and will start proposing course content realignment to MSE faculty for feedback.
- The department is making an immediate change for fall 2014 regarding MSE 238, Engineering Statistics, which will be changed from a quarter course to a half year course, and another quarter course (MSE 201, Materials Selection in Design I) will be eliminated since it largely overlaps with a more advanced fourth year course on the same subject. This will strengthen the program mathematics content, which was just above the CEAB's accreditation requirement, including statistics, which has been identified by alumni and industrial partners an area of weakness. This is a first step toward a long-term goal to phase out all the quarter courses in MSE, aside from those in the Engineering Communications track.
- In parallel with the above, the Materials One initiative will compare MSE-related content in the three classes (MSE101, APS104, and MSE 160), and will begin to identify common course content that will be modularized in stages over the next three years.

Medium term goals (2-3 years):

- The curriculum committee will flesh out concrete changes to the curriculum, to be implemented in stages with a goal of implementing major changes starting in the fall of 2015. The first series of changes will be brought forward to the Faculty's curriculum committee in the fall of 2014.
- The overall goals of this reform will be to:
  - streamline the number of core course required by eliminating some course overlap, and to reduce the number of technical electives offered
  - devote the second and third years to fundamental knowledge and to move most electives to fourth year, and
  - ensure that core concepts are reinforced throughout the program for students to understand the relationships between different courses and areas of knowledge, and to "get the big picture".
- The first year course content will continue to be modularized and tested in the classroom in stages for the last two years of this three-year project.

Long term goals (4-5 years):

- The outcome of the curriculum reform will be assessed in the 4-5 year time period, in advance of the department's next CEAB accreditation review.

The reviewers encouraged the development of a core set of graduate courses and to regularize the offering of specialized courses.

One of the motivations for streamlining undergraduate course offerings is to release faculty time to teach more graduate courses. While the department has been increasingly successful in offering more graduate courses, the reviewers are correct to note that there is no overall structure to the graduate curriculum.

MSE's graduate curriculum committee has focused in the last several years on clarifying some of the departmental policies with regard to the graduate programs. One of the issues identified has been the creation of core courses, in particular the need to strengthen the background knowledge of graduate students who do not have an MSE undergraduate degree. This has been dealt with in the past with the departmental qualifying exam for Ph.D. candidates, which to some extent tests general MSE knowledge. No equivalent test of knowledge is given to Masters candidates. At the same time the number of M.Eng. students, who are required to take a large number of classes for their degrees, has steadily grown.

Short term goals (within the next year):

- The Faculty graduate curriculum committee will be asked to consider core graduate courses, and to what extent students with MSE undergraduate degrees could be exempted from some of them.
- The committee will also consider whether to offer a set of courses that are specifically designed for the M.Eng. track.

Medium and long Term Goal (2-5 years):

- A revised graduate course structure will be rolled out in stages over the next 2-4 years.

RESOURCES

The reviewers observed that allocation of space can impede research programs of newer faculty.

We recognize that allocating sufficient space to newly hired faculty is extremely important. The department has re-established a Space Committee that will examine the current space audit for the department. At the same time, it will consider the development of a space policy similar to those currently in force in other FASE departments.

Short term goals (within the next year):

- We anticipate the recommendations from MSE's Space Committee to be received by the spring of 2014, at which time the Chair will begin reallocating space.

Long term goal (4-5 years):

- The department will develop a space policy that will provide a guide and a rationale for future space allocations.

The department has also received a large CFI grant to completely renovate the MSE department electron microscopy facilities. This common research facility will benefit all research programs in MSE and across FASE. This renovation has no impact on faculty lab space.

While the reviewers praised the innovative use of Tabletop Labs, they noted that undergraduate laboratory space is limited, reducing the possibilities for further hands-on learning.

We acknowledge that the undergraduate labs have been in need of updating for many years. Some progress has been made over the last years by using funds from the undergraduate student levy. The care and supervision of the undergraduate labs has also improved with the creation of a permanent staff position specific to these labs; this was done in January 2012.

Short term goals (within the next year):

- This fall, the department will open the Walter Curlook Materials Characterization and Processing Laboratories. This new facility was made possible by a generous donation from an alumnus. The labs will be made available to undergraduate courses and will support both undergraduate thesis projects and graduate research. The space for these labs was reallocated from research space, and adds to the existing inventory of lab space for undergraduate students.

Long term goals (4-5 years):

- The renovation and expansion of undergraduate laboratories remains one of the primary fundraising goals for MSE. The department will make efforts to attract more donations to update the undergraduate labs.

In addition, one of the primary fundraising goals for the Faculty during the BOUNDLESS Campaign has been for the construction of a new building: the Centre for Engineering Innovation and Entrepreneurship (CEIE), to open in the fall 2016. This building will expand significantly FASE's inventory of classroom space, with TEAL and tutorial rooms which can be used for labs. The new building will also include a student workshop, and light fabrication facilities for general design and build. While not specific to MSE, CEIE will provide students with many more opportunities for hands-on and laboratory experience.

FACULTY

The reviewers identified the need for a mentoring program for new faculty.

The reviewers are correct in noting that mentoring new faculty has been done on an informal basis in the past, with the Chair having monthly meetings with each assistant professor. The reviewers' report also noted that some associate professors were unclear on the criteria for promotion to full Professor.

Short term goals (within the next year):

- The department will formalize a mentoring program at the assistant professor level by pairing new faculty with specific experienced faculty, and by continuing the practice of providing examples of past portfolios from candidates who have successfully undergone either their third year review or their tenure review.
- Monthly meetings with the Chair will continue.
- The department will ask its representative on the Faculty's promotions committee to meet with all its associate professors to clarify the criteria used for promotion to full Professor.

Long term goals (4-5 years):

- The department hopes to revitalize the activity of the Research Committee, so that MSE faculty are made better aware of cross-Faculty initiatives and funding opportunities that are identified by the Vice-Dean Research, and so that new faculty can be guided in the development of proposals in any of these new initiatives.

The reviewers identified the need for equity and diversity training for search committees.

The Faculty has made great strides in being proactive in finding a diverse pool of qualified candidates, and in fact over the last six years, a very large proportion of newly hired assistant professors have been women. The MSE department is acutely aware that it has only one female faculty member, and thus has a weak record in gender balance in FASE.

Short term goal (within the next year):

- MSE currently has an open faculty search in extractive metallurgy and the search committee has been tasked with actively recruiting candidates, with a focus on identifying excellent female candidates.

Long term goals (4-5 years):

- The department will explore opportunities for diversity training for future search committees.
- The long term goal is to have a faculty gender balance that meets or exceeds the gender ratio in the MSE student population, which is about 25-30% female.

The reviewers suggested making strategic junior faculty hires and increasing the complement of computational materials professors.

We recognize the importance of computational materials science, particularly in the context of two broad trends in the MSE discipline: Integrated Computational Materials Engineering (ICME), and the Materials Genome Initiative (US). Both of these initiatives are built around accelerating the development of new materials with modeling. Professor Chandra Veer Singh was the first hire in this area, joining MSE two years ago.

Short term goal (within the next year):

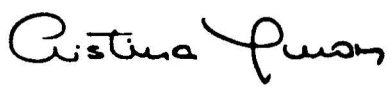
- The department will continue to support Professor Singh in his efforts to introduce more computation and facility with different software packages as an integral part of our undergraduate population.

Long term goals (4-5 years):

- As outlined in the current departmental strategic plan, MSE plans to hire at least two new faculty in the area of process metallurgy within the next few years. One of these hires could be a computation person. A new faculty member in the area of computational thermodynamics would complement Professor Singh's expertise, and at the same time support the department's effort to rebuild its metallurgical expertise.

Thank you very much for the opportunity to respond to the report of the external review team. Their comments and concerns have helped sharpen the vision and future priorities for the Department of Materials Science and Engineering.

Sincerely



Cristina Amon

APPENDIX

Externally commissioned reviews of academic programs completed since the last report to AP&P

Additional reviews of programs are conducted by organizations external to the University most commonly for accreditation purposes. These reviews form part of collegial self-regulatory systems to ensure that mutually agreed-upon threshold standards of quality are maintained in new and existing programs. Such reviews may serve different purposes than those commissioned by the University. A summary listing of these reviews is presented below.

These reviews are reported semi-annually to AP&P as an appendix to the compendium of external reviews.

Unit	Program	Accrediting Agency	Status
Faculty of Applied Science and Engineering	Chemical Engineering, BASc Civil Engineering, BASc Computer Engineering, BASc Electrical Engineering, BASc Engineering Science, BASc Industrial Engineering, BASc Materials Engineering, BASc Mechanical Engineering, BASc Mineral Engineering, BASc	Canadian Engineering Accreditation Board (CEAB)	Accredited for six years to June 30, 2019: Chemical Engineering, BASc; Civil Engineering, BASc; Industrial Engineering, BASc; Materials Engineering, BASc; Mechanical Engineering, BASc Accredited for three years to June 30, 2016; report required by June 30, 2015: Computer Engineering, BASc; Electrical Engineering, BASc; Engineering Science, BASc; Mineral Engineering, BASc
Faculty of Medicine	Bachelor of Science Medical Radiation Science (3 streams all accredited individually by CMA)	Canadian Medical Assocation (CMA)	Accredited for six years to April 30, 2019 : all streams – Nuclear Medicine Technology, Radiation Therapy, Radiological Technology
Faculty of Medicine	Bachelor of Science Physician Assistant	Canadian Medical Assocation (CMA)	Accredited for six years until December 31, 2017
Faculty of Pharmacy	Post Baccalaureate PharmD Pharmacy, BScPhm PharmD (entry to practice)	Canadian Council for Accreditation of Pharmacy Programs	Post Baccalaureate PharmD fully accredited for six years, 2013-2019. Pharmacy, BScPhm fully accredited for two years, 2013-15. PharmD (entry to practice) provisionally

			accredited for three years, 2013-2016. ("Provisional status is awarded to new programs that have students enrolled but has not graduated a class of students. This status denotes a developmental program that is expected to mature in accord with stated plans and within a defined time period.")

terials Science and Engineering Department
University of Toronto
External Review Visiting Committee Report
May 13-14, 2013

Introduction

The Review Committee, made up of Professor Lorna Gibson (Materials Science and Engineering, MIT), Professor Hani Henein (Department of Chemical and Materials Engineering, University of Alberta), Professor Gary Purdy (Materials Science and Engineering, McMaster University) and Professor Stephen Yue, (Chair, Department of Mining and Materials Engineering, McGill University) visited the Materials Science and Engineering (MSE) Department at the University of Toronto on May 13-14, 2013. Prior to their visit, they were sent documentation from both the Department and the Faculty of Applied Science and Engineering, including the Department Self Assessment, the prior 2008 Review Committee Report, the Department Strategic Plan, curriculum vitae of faculty in the Department; the Faculty Annual Report; and the five-year Academic Plan. Additional documentation requested during the visit was provided. During the visit, committee members met with Dean Cristina Amon; the Department Chair; Associate Chair, Undergraduate Studies; Associate Chair, Graduate Studies; Advisory Committee on the Appointment of Chair; faculty, administrative and technical staff; and a small group of undergraduate and graduate students. The Review Committee toured undergraduate teaching labs as well as central facilities and selected research labs.

Undergraduate Education

The Department's undergraduate program attracts high quality students and has an enrolment of about 50 students per year, up from about 40 ten years ago. The undergraduate students we met with were generally satisfied with the program.

The Department devotes considerable resources to teaching three first year service subjects with high enrolments, largely for other departments:

- MSE 101 Introduction to Materials Science, for students in Chemical, Mechanical and Industrial, Civil and Mineral Engineering as well as Materials Science and Engineering
- MSE 160 Molecules and Materials, for students in Engineering Science

APS104 Introduction to Materials and Chemistry, for students in TrackOne and ECE

The first year subjects are using a number of innovative techniques such as students texting responses to short in-class quizzes, portable tabletop labs, and clever demonstrations in the lectures. The delivery of these courses seems well structured and effective.

The Department also delivers an undergraduate curriculum to students in MSE as well as courses to students taking the Nanoengineering major in the Engineering Science program. The main recommendation of the previous Departmental review in 2008 was that the Department reform the undergraduate MSE curriculum to address their constrained teaching resources. In particular, that review recommended that the MSE curriculum should be updated to:

- Focus more on fundamental courses
- Reflect current research developments within the department
- Reduce the number of electives
- Require students to take classes in chemistry and statistics (for example) from the Faculty of Arts and Science, rather than MSE
- Prepare students for a career that will be dynamic rather than static (with one industry sector).

Since then, there has been discussion of various aspects of the curriculum reform, including:

- moving courses covering fundamentals to years 2 and 3 of the program and covering electives in year 4;
- coordinating "clusters" of subjects in certain areas (e.g. math, thermodynamics, structure) to fill in gaps and reduce overlaps in the curriculum;
- eliminating the four quarter courses in nanomaterials, biomaterials, manufacturing, and materials processing and sustainable development;
- making the thesis optional, perhaps with an alternative industrial practice option or a multidisciplinary design subject;
- considering the future of the Nanoengineering major in Engineering Science (to which the department contributes subjects) which has falling enrolments;

The third and fourth items have been agreed on in principle. We recommend that the Department undergraduate curriculum committee develop a plan for curriculum reform that addresses each of these issues. It is also recommended that the Faculty, the MSE Department, and the Division of Engineering Science consider

ablishing an optional track for Computational Materials Science instead of the current Nanoengineering option.

The 2008 Review Committee also expressed concern that the undergraduate labs needed renovation and equipment; these concerns have been addressed. The novel Portable Tabletop Labs for the first year labs are viewed as highly successful. The Department has recently obtained substantial CFI, Ontario Research Fund and industrial funding (~$16M) for a major upgrade of the electron microscopy and other facilities, including both equipment and space renovations that will be implemented over the next 18 months or so. While this is largely for research purposes, we anticipate that this equipment will also be used in undergraduate teaching.

The undergraduate students we met with (a rather small sampling of four students) were generally satisfied with the program and the quality of the teaching. The PEY program is popular among the undergraduate students, with placements in a broad range of materials and engineering companies. The students are highly valued by those companies; most are offered employment from the company following the internship. The Department offers opportunities for study abroad, through pre-approved programs (e.g. with NUS in Singapore); while this is highly commendable, it is unfortunate that few UofT MSE students take advantage of this opportunity. Town hall meetings held by students offer an opportunity for open discussion of issues. The undergraduate students we spoke with did not appear to be involved in professional societies; they should be encouraged to do this.

The main concern of the undergraduates we spoke with was career opportunities immediately after graduation. They would like more career advice to be available. We also heard that the Departmental administrative staff provided some advice, but only about 10% of the students made use of this resource. Career advice is also available from faculty and the Engineering Career Center. The students should be made aware of all of the resources available for career advice.

The undergraduates also had several specific concerns. They would like to see more practical applications taught in the subjects. One particular problem this year was that the Calculus/Differential Equations class, taught by the Department of Mathematics, did not cover differential equations and that this made a subsequent Computational Materials Science class difficult. The Department is aware of this problem and plans to address this through discussions with the Department of Mathematics.

aduate Education:

Graduate Programs:

The Department offers programs leading to the degrees of Master of Engineering, Master of Applied Science, and Doctor of Philosophy, all in Materials Science and Engineering. The Master of Engineering degree is a course-only program. No research supervision is therefore required. Admission is open to all qualified candidates; the more exceptional of these can apply to switch to the MASc program.

Admission to the MASc program requires that a supervisor be found as part of the admission process. Candidates for admission are screened at the Departmental level for academic credentials; if admissible, their files are posted electronically for consideration by potential supervisors. Current MASc students may choose to complete their degree programs, or may apply to fast-track to the PhD program without completing the MASc. There is no direct route to the PhD from the bachelor's level.

About one-half of the graduate students in MSE are doctoral degree candidates. Each has an advisory committee, which is required to meet formally on a regular basis. Funding for doctoral candidates is guaranteed for four years after the Master's, although the average time to completion is rather higher.

We spoke with five graduate students at various levels (MASc, early and senior PhD), and encountered a high level of satisfaction with their programs and supervision. Curiously, three of the five were associated with one faculty member's group. Several had co-authored journal publications, one had delayed publication because of a patent application, and another had given oral presentations at two international conferences. A shortage of specialized graduate courses (at appropriate stages in their research projects) was seen by some as a difficulty. In spite of the current students' enthusiasm for the program, the committee noted that exit survey results suggested a small but significant level of dissatisfaction among graduates; it would be of interest to learn the cause.

Funding of research degree candidates:

The additional costs to research grants of supporting international students, due to the visa fee differential, is a major disincentive to their acceptance by faculty members in MSE. The current minimum level of annual funding is $15,000 plus tuition. International students in MSE each currently represent an additional cost to research grants of about $15,000 over the cost of domestic students. The

fferential cost varies from one department to the other: it is often financially attractive to register a visa student in another department (especially in cases where faculty members are cross-appointed), and this is seen as a consequence of the newly devolved financial system. The committee notes that the differential cost of international students will very likely have an adverse effect on the quality and cultural diversification of the graduate student body in MSE.

Graduate courses:

The visiting team heard that undergraduate teaching loads are particularly high in MSE, and that this represents a limitation to the offering of a greater selection of specialized graduate courses. In discussion, and consistent with the previous 2008 review, it was suggested that a set of core courses in MSE (consisting, for example, of advanced courses in mechanical response of solid material, thermodynamics of materials) be defined and regularly offered, and that other, more specialized topics be covered in alternate years. The resulting efficiency would then parallel a similar efficiency to be gained by a restructuring and streamlining of the undergraduate offerings.

The development of core material for all MSE graduate students is recommended, not only on the basis of efficiency, but as a way of ensuring that all who graduate with MSE degrees are conversant with the fundamental aspects of materials science at the graduate level, and with the ways they play out in the main families of solid materials. A set of comprehensive examinations, based on the content of these core courses, could be developed to serve as a by-pass route for students who were sufficiently grounded in materials fundamentals. This revision of the graduate offerings would represent a significant amount of work for the graduate curriculum committee; it is however strongly recommended as an avenue to the improvement of the graduate student experience as well as a leavening of the faculty teaching load.

Other ways of maintaining a spectrum of specialized offerings might include enhanced collaboration with neighbouring universities (perhaps using distance education technology) and the use of reading course formats. We advocate the use of graduate advisory and website mechanisms to inform students of these possibilities.

culty and Research

There are currently 17 Professors: three Assistants, five Associates and the balance, Full Professors. Of the Full Professors, one has essentially retired and there is another that is 'close' to retiring, although he neither confirmed nor denied this. There is definitely a need to renew the MSE faculty. One search is ongoing, and two more hires are planned, which would improve the balance between young and experienced faculty.

The Assistant Professors were generally very pleased with the resources available to them. The start-up funds were adequate and the track to retention and promotion seemed clear to them. Although there is no formal mentoring process in MSE, these young faculty members meet with the MSE Chair once every two months to discuss progress. They seem to be satisfied with their orientation to the UofT and felt that their required service work was reasonable. Overall, they felt valued and were happy to be on campus. The issue of the lack of availability of space was an issue for young faculty wishing to do experimental work.

There is no formal mentoring process for new professors. In a small department, it is tempting to say that mentoring need only be ad-hoc, but in general a formal procedure is a better approach. For example, the Associate Professors interviewed were unclear as to the procedures, criteria, etc. for promotion to Full Professor. The other departments in FASE seem to have well-structured mentoring, and there was a comment that, because of the small size of MSE, such mentoring schemes were beyond the resources of the Department. Mentoring the Assistant Professors in grantsmanship was also informal. One of the new professors felt 'disappointed' with the level of his Discovery Grant and he might have benefitted from a formal review, although he did pass it to a couple of colleagues outside MSE for a review.

The MSE plan is to hire in the more traditional area of 'process' metallurgy, which was a recognized strength of MSE many years ago. At least part of the rationale seems to be that the lion's share of MSE undergrads find jobs in this area, which is a powerhouse of the Canadian industry. The past decade, which saw a strong move away from 'process' metallurgy, seemed to have been a strategy to increase student enrollment, so it remains to be seen whether this move towards 'process' will affect enrollment. However, despite this hiring focus, MSE will remain strong in nano, bio and electronic materials for some time to come. The current faculty seemed to be in accord with this hiring policy. It is also

commended that MSE increases its complement of computational materials professors.

The previous Review Committee report noted the lack of gender and cultural diversity in the faculty. This is still largely the case, but there is an opportunity to improve this metric with the new hires, as long as the search committee is on board with the benefits of diversity. Strengthening the recognition of diversity in hiring is a must.

In general, the faculty seemed to be reasonably content with the institutional support but there are space allocation issues. The undergraduate and graduate course offerings are somewhat contentious, as is noted in other sections of this report. Some of these issues reside in the ability to implement change. The undergraduate 'academic' and graduate 'academic' committees seem to be one-man committees, which is unlikely to make much headway in implementing any radical change. At the very least, ad-hoc committees need to be formed to consider changes in the program.

The faculty teaching load is three courses but, because of the extent of the undergraduate program and the size of the faculty, almost all of these courses are undergraduate ones, leaving little time for the faculty to create graduate courses, which in turn is detrimental to the graduate course offerings. This is a source of frustration for both grad students and the faculty, but might be solved by rationalizing the undergraduate program.

While cross-appointments are usually beneficial, the fact that all three cross-appointments in MSE are 49% may be problematic. These cross-appointees were quite frank about the fact that there was more monetary incentive to register students in the 'other' departments. In particular, in the case of the ECE cross-appointment, the professor had three times as many ECE students as MSE. Such a level of imbalance is, perhaps, not very healthy in the long run for the MSE, and may possibly impact on future promotion prospects of cross-appointees, which depends on input from both departments. There is also an issue concerning overhead only going to the 51% department while space costs are shared.

Some faculty commented on the need for financial flexibility when hiring international graduate students. The amount needed to be able to accept a student includes tuition, which is much higher for international students than for domestic students. The ability to accept international students who have some level of self-funding was suggested.

The Department's research activities are strong, with vibrant research groups covering a diverse set of topics. Faculty have been particularly successful in obtaining funding for both research and infrastructure. One metric of a globally top rated program is the level of interaction, long standing and sustained research activities with industry. The NSERC Synergy Award and the Brockhouse Canada Prize received by Professors Perovic and Coyle, respectively, are good evidence of such quality and recognition. Another metric is the number of NSERC Strategic Project Grants. It is highly commendable and rare to see that five Strategic Grants have been awarded to the faculty in the Department. While the faculty have been very creative and successful in securing funds from NSERC, more efforts should be directed to long and sustained relationships with industry through NSERC CR&D and IRC Grants. These programs should be considered as the MSE Department is shifting away from 'nano for its own sake' and more into the Energy and Sustainability themes.

The materials characterization facilities in the Department are in the process of being renewed with the recent award of a CFI Grant and the Walter Curlook Materials Characterization Lab fund. This will provide a desperately needed renewal of high end characterization equipment complementary to what is available nearby elsewhere in Ontario. The plan is well thought out and organized. It clearly has provided a moral boost to both technical staff and faculty members in MSE.

In summary:

- The current faculty are well grounded and have a high morale.
- The faculty appreciates the efforts of the support staff.
- Space remains an issue.
- MSE will add two new professors to their current complement, which will compensate for the loss of two faculty. This will probably improve the balance of the Professoriate, which is skewed to Full Professors.
- The current research activity is concentrated in 'advanced materials', which continues to be a recognized strength of MSE.
- The Review Committee is supportive of new hires being targeted in 'process metallurgy', which speaks to the needs of the Canadian Industry and will renew this important research effort.
- The Review Committee recommends increasing computational materials faculty, either by creating a new position or by collaborating

th other FASE units such as the Department of Mechanical and Industrial Engineering, or the Institute for Aerospace Studies.
- The faculty are very productive in research, with regard to the usual metrics.
- They appear to be somewhat overburdened with undergraduate teaching, but this can be resolved by rationalizing the undergraduate program.
- Cross-appointments are problematic especially in terms of graduate students, where it is more monetarily beneficial to register students in for example ECE rather than MSE. This must be addressed.
- Committees comprised of active professors should be established, at least for undergraduate and graduate programs.
- The faculty, especially the search committee, need to be educated in the benefits of diversity and then should act on this.
- Mentors and grant readers should be formally assigned by the Chair to facilitate success and timeliness in promotions and funding.

Administration

Administrative and Technical Staff complement:

The administrative staff while small in number are very efficient, collegial, and seem well connected to the undergraduate and graduate students' needs. They also provide efficient service to the faculty members in accounting and administrative functions. The undergraduate recruiting efforts are diverse and active with regular high school visits and the use of digital social networks to promote the MSE program. The graduate recruiting is mainly based on a digital approach. It seems that this approach has been sufficient to attract a reasonable number of quality domestic graduate students into the MSE program.

The technical staff are professional and very knowledgeable. The space available for undergraduate laboratories is well maintained but is limited in scope. A great deal of effort is being focused on the effective and efficient utilization of space through the use of 'laboratories in a suitcase'. The limited space allocated to undergraduate laboratories requires an efficient mechanism for time management and organization of the flow of students. While the current space budget cost model is driving these innovative methods of laboratory delivery, it detracts from the quality and effectiveness of knowledge transfer and hands on learning by students. It also requires significant time on the part of personnel in set-up, take down and maintain equipment. This results in higher actual and in-kind costs in laboratory delivery. Space limitations will be partially alleviated with the Faculty's

w Center for Engineering Innovation and Entrepreneurship, targetted to open in 2016.

Computational resources:

Computational resources for teaching and research appear to meet the current and future needs of the MSE program. Software packages such as Ansys, Abacus, MatLab, CES (materials selection) and others are readily available. The computational resources could be strengthened by the addition of software for computational thermodynamics; efforts should be directed to obtaining them and integrating them into the undergraduate and graduate MSE programs.

Advancement

With the current budget model in the Faculty of Applied Science and Engineering, the MSE Department is disadvantaged in attracting graduate students in specialty areas where there is cross-appointment of faculty members. While there are many benefits to such a cross-appointment, efforts are needed to increase the research credits that should flow to MSE for such collaborations. Efforts are needed to develop an endowment fund that ultimately enables graduate scholarships for students in MSE as well as for reducing the cost differential between domestic and international students. The objective is to attract top quality graduate students based on their merit rather than be driven by budgetary pressures.

Positioning

One of the metrics of a globally top rated program is the number and stature of external visitors to a Department delivering technical seminars. With such a vibrant and active faculty complement, many such visits must be taking place. The only visit identified in the package is the information on the Winegard Visiting Lectureship. Efforts should be directed to collect such information. Furthermore, an endowment can be considered to help fund more named guest lectures such as the Winegard Visiting Lectureship. This would increase the international visibility of the MSE program at the University of Toronto.

Departmental Management and Leadership

The position of Departmental Chair is demanding: it requires a mélange of qualities that include vision, diplomacy and the ability to motivate, inspire and delegate. The chair of a department must maintain productive relationships with faculty, staff, and student bodies. He or she must also advocate for the department in dealings with other (often larger) departments and other entities within and

ternal to the university, and ensure that the department and its components are treated fairly. The job is made more interesting by the knowledge that the incumbent will probably re-join the ranks of faculty at the end of his or her term(s).

Since each department comprises a number of distinct interacting components, it is also vital that the Chair exercise leadership in bringing these communities together in the pursuit of the departmental teaching, research and service objectives.

The Toronto MSE faculty is made up of a majority of senior members and a lesser number of promising junior faculty. The Chair will ideally exercise his or her role in such a manner as to encourage and support both senior members and their younger counterparts, and take an active part in recruitment of further appointees while keeping watch on considerations of excellence, equity and diversity. The committee believes that the current Chair possesses a quiet and effective leadership style. The general level of satisfaction and pride expressed by those members of staff, student and faculty bodies interviewed appears to attest to the mentoring and leadership skills of the incumbent Chair.

The committee also notes the Department's strong performance in obtaining research support. The NSERC Strategic Grants competition was extremely competitive this year; the Department received a significant fraction of the total awarded to MSE applicants in Canada. To the extent that this and similar performance is due to encouragement by the Chair, Professor Nogami is to be commended.

The Department is at a point of transition. Faculty renewal is a priority, as is the streamlining of undergraduate and graduate curricula. The acquisition of increased, stable external funding for research should also be addressed. Relations with other universities, industries, professional societies, and the alumni community need to be strengthened. Addressing these issues will require the buy-in and full participation by all members of the Department; this will be facilitated by the appointment of a Chair with a collegial style. Professor Nogami has gained the confidence of the Department and the University community during his first term as Chair, and has expressed willingness to stand for a second term.

Without attempting to appropriate the appointments process, this committee recommends that the re-appointment of Professor Nogami be given serious consideration.

nclusions and Main Recommendations

The Materials Science and Engineering Department at the University of Toronto is strong and highly successful. It attracts high quality students and faculty, with broad interests in the field of materials science and engineering.

The educational resources of the Department are largely devoted to the undergraduate program, including three large service courses for other departments. We recommend that the Department reform the undergraduate curriculum to allow more resources to be devoted to graduate courses; the undergraduate curriculum committee should move this forward and develop buy-in from the faculty. It is recommended that the space utilized for first year service courses be exempt from Departmental space budgets and dealt with at the Faculty level. We also recommend the development of core courses for all MSE graduate students, not only on the basis of efficiency, but as a way of ensuring that all who graduate with MSE degrees are conversant with the fundamental aspects of materials science, and with the ways they play out in the main families of solid materials. The Department should offer a broader range of graduate courses.

The additional costs to research grants of supporting international students, due to the visa fee differential, is a major disincentive to their acceptance by faculty members in MSE. The differential cost of international students will very likely have an adverse effect on the quality and cultural diversification of the graduate student body. Efforts are needed to develop an endowment fund that ultimately enables graduate scholarships for students in MSE as well as for reducing the cost differential between domestic and international students.

The committee supports the plan to hire of additional faculty in process metallurgy as well as in computational materials science. The Department should strengthen the diversity of the faculty. We recommend a more formal mentoring process for junior faculty.

More efforts should be directed to long and sustained relationships with industry through NSERC CR&D and IRC Grants.