UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

Report No. 3414

MEMORANDUM

To: Faculty Council

From: Dr. Micah Stickel
Chair, First Year

Date: December 5, 2013

Re: **Core Curriculum Review Task Force – Update for December 11, 2013 Faculty Council**

REPORT CLASSIFICATION

The attached update of the Core Curriculum Review Task Force is for discussion purposes only.

OVERVIEW

For the first time in over 12 years the Faculty has set out to review the content and delivery of its first-year (core) curriculum for the Core 8 and General First Year (TrackOne) programs. In March 2013, a Decanal Task Force was established with the following Terms of Reference:

1) To examine the existing content and delivery of all of the course offerings in first year;
2) To examine the student response to these course offerings;
3) To identify the strengths and weaknesses of our existing course offerings;
4) To assess the existing and evolving foundational educational needs of all FASE programs;
5) To explore opportunities to develop synergies, or provide allowance for transferability, between programs
6) To examine the best practices in engineering education including examining the First Year curricula and delivery at other leading comparative engineering educational institutions;
7) To recommend changes, if any to the content or delivery of the First Year courses.
8) To identify and recommend a course of action for implementation of any proposed changes.

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This Task Force consists of Micah Stickel (chair), Jason Bazylak, Tim Bender, Evan Bentz, and Costas Sarris. Since that time, the Task Force has:

1) Reviewed the current Core 8/TrackOne core curriculum,
2) Solicited the student, departmental, and instructors' views of the current core curriculum,
3) Assessed the on-going and future needs of the departments, students, and the Faculty for the core curriculum,
4) Explored opportunities for the integration of the Core 8, TrackOne, and Engineering Science cohorts,
5) Surveyed current and best practices within other North American engineering institutions, and
6) Developed a set of potential recommendations and associated curriculum models that address our common needs, while maintaining opportunity for program transfer after the first year.

We have found that the current core program has many positive aspects, including its strength and breadth of foundational material, its interesting and challenging courses, its focus on engineering design, communications, and teamwork, its engaged faculty, and its talented and hard-working group of students.

However, the students, the departments, the first-year instructors, and the Task Force have identified some specific areas in which the core curriculum needs to be improved, while building upon these strengths:

1) *Relevance and Course Integration*
   There is a significant interest in creating a more cohesive and connected curriculum, in which the fundamental mathematics and science courses are interwoven with core engineering concepts and applications.

2) *Development of Transferable Engineering Skills and Attributes*
   Increased emphasis and instruction should be placed on transferable skills and attributes such as problem solving, systems modeling, leadership, independent learning and critical thinking, and appreciating the complexity of real engineering problems.

3) *Engineering Computation*
   Many departments identified the need to introduce students to a numeric computation tool, such as MATLAB, and integrate this into the curriculum. In addition, there was broad consensus on providing students with a strong foundation in fundamental programming skills and algorithmic thinking, while at the same time using a specific programming language that meets the unique needs of the students in various departments. Finally, both departments and students highlighted the potential usefulness of basic introductions to other computer software such as Excel and Word.

4) *Workload*
   The workload within the curriculum needs to be reduced and better managed to provide students with the opportunity to reflect on their learning, effectively assimilate their new ideas, and develop their own programmatic and career goals.

5) *First-Year Teaching Community*
   Efforts are needed to create a stronger and better equipped first-year teaching community, one which integrates instructors, teaching assistants, and support staff together to deliver a more effective and enriched student learning experience.

In order to address these identified needs, the Task Force has developed a set of preliminary recommendations and associated curriculum models as a starting point for discussion within the Faculty. It is understood that to embrace these new priorities, existing components of the curriculum would have to be changed, and these are summarized in the table below.

This update report is the start of a larger conversation within the Faculty related to these findings and the proposed recommendations and associated curricular models that have been developed. The societal and industry landscape that our engineering graduates face is now in continual flux. As a Faculty we now have an opportunity to define the attributes we value and will foster as a group, which will serve our alumni throughout their career. It is envisioned that the first-year program will continue to be a strong and rigorous foundational experience in core mathematical and scientific principles, yet will also enable students to begin the development of the fundamental skills and attributes needed by our graduating engineers.

Priority	Primary Advantages and Relevant Aspects of the Proposed Curriculum Models	Requirements and Impacts
Commonality within the Curriculum	• To ease transferability between programs, the curriculum must be adjusted to have a more common first-year experience. • A more common curriculum also has the benefit of a broader exposure of fundamental sciences for all students. For example, an Introduction to Chemistry course could provide a stronger foundation in chemistry to students in ECE and TrackOne, while enabling a greater understanding of environmental effects for all students through the discussion of the water cycle. • A move to a common curriculum would require the Faculty to identify the material that is truly foundational for an engineering degree.	• The primary disadvantage of such a change is that some departmental-specific first-year content and/or courses would be removed. • This might include CME185: Earth Systems Science and CHE113: Concepts in Chemical Engineering. • Reduction of coverage might occur in ECE110: Electrical Fundamentals and MSE101: Introduction to Materials Science. • In any scenario, it is proposed that we maintain the current system of departmental-specific admissions with a 20% TrackOne (or General First Year) cohort.
Relevance and Course Integration	• The literature suggests that a tighter integration between courses and better motivation of the material has the potential to improve student engagement and their appreciation for and retention of the fundamental mathematical and scientific concepts. • Improved focus on relevance would enable the placement of mathematics in an engineering context.	• Such integration would require significant coordination, and likely necessitate the creation of a new faculty position for this purpose. • Increase relevance would result in a reduction of linear algebra coverage in the first year. For example, perhaps less emphasis would be placed on general vector spaces and subspaces.
Transferable Engineering Skills and Attributes:	• Within the current proposed models, the specific instruction on and development of problem solving skills would become part of the Mechanics course (CIV100). • The experience with systems modeling and examples of this process would be discussed in the Dynamics course (MIE100). • A preliminary introduction to ethics would be incorporated into either an Engineering Orientation course or Engineering Strategies and Practice (ESP).	• For CIV100 and MIE100, between 15% to 20% (or approximately 5 to 7 lectures) of the current material coverage would have to be removed to accommodate these new components. • The ethics course (APS150) would be removed and a preliminary discussion of ethics in the university context (i.e., Code of Student Conduct and academic offenses) would be retained in the first year. • The second part of APS150, relating to ethics

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	• ESP I and II would continue to provide students with the opportunity to develop their engineering design, communication, leadership, and teamwork skills.	in the professional engineering context, would have to be introduced in a third or fourth year course in all departments.
Engineering Computation	• In order to meet the diverse programming language needs of the departments, it is proposed that two programming courses are offered in the winter term. One course focused on C, one focused on Python or MATLAB. • The creation of a significant MATLAB component to the curriculum would enable students to better understand numeric analysis and develop their visualization skills.	• To support transferability, summer online mini-courses could be developed to help students transition from one language to the other.
Workload	• To assess a student's academic workload three primary aspects must be considered: a) *Instruction*: Expectation to learn and understand new concepts (typically related to total number of lecture hours), b) *Course work*: This includes problem sets (homework), labs, and/or projects, and c) *Assessments*: This includes quizzes, tests, midterms, and final exams.	• To address item a), it is proposed that some conceptual material be removed from the first year courses. For example, it might be possible for some concepts to be removed from APS112: Engineering, Strategies, and Practice II, ECE110: Electrical Fundamentals, MAT187: Calculus II, and MSE101: Introduction to Materials Science. • To identify appropriate material to remove, small working groups within the Faculty would need to closely examine each of the core courses and how they interface with second-year departmental programs. • To alleviate the course workload related to items b) and c), it is hoped that a more integrated and holistic design of the first-year curriculum will result in a more strategic use of the students' time both inside and outside of class.