UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

Report No. 3457

MEMORANDUM

To: Executive Committee of Faculty Council (January 20, 2015)
Faculty Council (February 10, 2015)

From: Dr. Graeme Norval
Chair, Undergraduate Curriculum Committee

Date: December 12, 2014

Re: **Major First Year Curriculum Changes for the 2015-2016 Academic Year**

REPORT CLASSIFICATION

This is a major policy matter that will be considered by the Executive Committee for endorsing and forwarding to Faculty Council for vote as a regular motion (requiring a simple majority of members present and voting to carry).

BACKGROUND

The Undergraduate Curriculum Committee is tasked with managing the curriculum change process for the Faculty. This report summarizes the course changes for the first-year program for the Core 8 and Track One programs.

STRUCTURE

The proposed changes described below come in part as a result of the findings and recommendations of the Core Curriculum Review Task Force after extensive consultations with students, faculty, and external programs and literature. As well, these changes are motivated by ongoing assessment of the first year program facilitated by the First Year office.

1. Change in Lecture Contact Hours to APS112H1S: Engineering Strategies and Practice II

Currently, the second course in the Engineering Strategies and Practice Sequence has three lecture hours per week. Both students and faculty have found that these hours are not all necessary and some of the material covered is either repeated, could be presented in different ways, or are not required. While the exact changes are being considered further by the teaching team, some possible adjustments to ESP II are:

- Some of the communication material (phone & interview scripts, assignment walkthroughs, etc.) could be moved to optional videos.
- Some of the design materials (reverse engineering demo, implementation planning, case study videos) would be better suited as online videos.
- Reduction of discussion of advanced project management techniques and focus time on the PM tools being used in the tutorials for their term project.
- Reduction of coverage of Design for Safety from three lectures to two lectures, but addition of mandatory graded completion of the Ministry of Labour online worker safety certification.
- Reduction of coverage of Design for Manufacturability.

Thus, in order to make better use of students' time, it is proposed that the lecture contact hours for APS112 be reduced from three to two for 2015-2016.

2. Removal of APS150: Ethics in Engineering

In 2010, the Ethics in Engineering course was introduced as a self-study seminar course to ensure that all Core 8 students had exposure to ethics in the academic and professional settings. The course culminates in a 100% multiple choice final exam in early November, with a 70% bar for the Pass/Fail grade. With this course structure, students simply memorize the relevant material rather than consider this more critically and personally integrate these ideas through small group discussions and other learning approaches, such as detailed case studies.

It is therefore proposed that this course be removed from the first year Core 8 and Track One curricula and that each department deliver a more engaging and relevant presentation and discussion of ethics in a professional engineering context in the third or fourth years of their programs. This will allow students to have more professional and/or work experience, which they can then bring to the deeper consideration of engineering ethics within their discipline. Currently the Faculty, in partnership with the University of Ottawa and Engineers Canada, is in the process of developing a set of online resources for a course on engineering ethics. It is expected that these resources could then be used as part of the upper year exposure to engineering ethics within the different departments.

It is also proposed that the first year program continue to lay a foundation for ethical conduct through a different approach. This would take place through a discussion of ethics in an academic setting including an introduction to the Academic Code of Conduct, plagiarism, academic misconduct, and an introduction to profession engineering ethics. These topics will be incorporated into the proposed Orientation to Engineering seminar course (see below) and Engineering Strategies and Practice I and II.

3. Creation of a Fall Term Seminar Course: Orientation to Engineering

This course is designed to augment the first-year student experience within the Core 8 and Track One programs by helping students to develop a greater understanding of the academic learning environment, the field of engineering, and how engineers think. One of the consistent themes from student feedback on the first year program relates to how they would like to have had a greater sense of what engineering is really like, what engineers do, and how the fundamental mathematics and sciences are used in an engineering context. As well, students often comment that they wish they had more support in making the transition in learning from high school to university.

The Faculty currently offers a series of weekly optional seminars called First Year Fridays, which in the fall term covers many of the important aspects of academic transition: study skills, time management, problem solving, successful teamwork, effective communications, wellness, Skule involvement, undergraduate research, and exam preparation and stress management. However, the attendance is very poor (<20 students), despite the positive experiences from those that attend and comments from upper year students that they would have really appreciated such seminars. Part of the intent of this course is to ensure these useful experiences are integrated into every first year student's fall term schedule, in a way that is meaningful for our students. By placing this course in the fall term, this will help students be better prepared for the Winter term, which is generally considered to be the more difficult of the two terms.

The proposed 0.25 weight credit course would be structured with six bi-weekly interactive lectures, 13 weekly tutorial seminars, and incorporate reasonable meaningful assessments throughout the course. The lectures would be coordinated by the Chair of First Year with teaching support from the First Year Office. The tutorial seminars would be run by trained undergraduate student mentors. The detailed development of the course and its assessments would be done over the summer 2015 through a collaborative effort between the First Year Office and a team of first, second, and third year students. A more complete description of the proposed course is included in the accompanying document.

It is important to note that this new seminar course would serve a very different purpose than the existing attendance-based Introduction to Engineering courses that currently exist for Track One, ECE, and MIE students[1]. These courses provide a detailed overview the different research areas, program options, and profession opportunities offered by the relevant disciplines and departments. Whereas, the proposed course will focus on the intentional transition into the engineering learning environment and profession.

4. Move ECE101 to the Winter Term

In order to avoid having seven courses for ECE students (including two seminar courses) in the fall term, it is also proposed that ECE101: *Introduction to Electrical and Computer Engineering* be moved to the Winter term, which is when both APS191 and MIE191 are currently offered.

[1] These are APS191H1S: Introduction to Engineering, ECE101H1F: Introduction to Electrical and Computer Engineering, and MIE191H1S: Introduction to Mechanical and Industrial Engineering.

5. Addition of a One-Hour per Week Laboratory Component to MAT188H1F: Linear Algebra

One of the core recommendations of the recent Core Curriculum Review was that numeric computation needs to be integrated into the first-year Core 8 and Track One programs. In order to do this, it is proposed that a one-hour per week laboratory contact time be added to MAT188H1F: Linear Algebra. This laboratory component would follow an inverted classroom model, where students would come to the computer lab prepared having watched a short series of videos and then make use of the computational tool in the lab with the guidance of TAs and the instructor. Over the course of these 12 hours of contact time, students would gain a basic familiarity with the computational tool such that use of this tool could be intelligently integrated into the assignments and homework exercises of the other courses.

6. Inclusion of an Online Course: Introductory Chemistry from a Materials Perspective into our Calendar

Over the past two years, the Faculty has been a proactive participant in the Ontario Online initiative and has received funding from the Ministry of Training, Colleges and Universities for the development of three online courses (APS162/163: Calculus for Engineers I and II, and APS160: Mechanics).

These courses have enabled the Faculty to offer new pathways to complete these core courses for our own students. Recently, it was announced that funding has also been granted to develop a new online course: *Introductory Chemistry from a Materials Perspective*. This course should be of interest to a broad range of students in Ontario. Thus, it is proposed that the online-only course be added to our Calendar so that we can deliver this to students external to our program and integrate this course or components of this course into our existing or future Core 8 and Track One first-year program.

This course is being designed such that it would be a reasonable transfer credit for our current APS104: *Introduction to Materials and Chemistry* course. As with our other online courses, this should allow our own students to have more ways in which they can complete their first-year requirements.

The course title and description are:

Introductory Chemistry from a Materials Perspective
This online course is structured around the principle of structure-property relationship. This relationship refers to an understanding of the microstructure of a solid, that is, the nature of the bonds between atoms and the spatial arrangement of atoms, which permits the explanation of observed behavior. Observed materials behavior includes mechanical, electrical, magnetic, optical, and corrosive behavior. Understanding this foundational structure-property relationship then allows scientists and engineers to control and carefully tailor the properties of materials. Progression through the course is guided by carefully selected real-world examples of high intrinsic interest. For example, the development of a high strength, high elastic constant polymer for use in the production of a

ballistic vest creates a rich environment for exploring hydrogen bonding and crystallinity in polymers.

Topics covered in this course include: structure of the atom, models of the atom, electronic configuration, the electromagnetic spectrum, band theory, atomic bonding, optical transparency of solids, magnetic properties, molecular bonding, hybridized orbitals, crystal systems, lattices and structures, crystallographic notation, imperfections in solids, reaction rates, activation energy, solid-state diffusion, materials thermodynamics, free energy, and phase equilibrium.

PROGRAM(S)

All relevant programs are involved in these changes, and the impact on students in the various programs has been considered.

PROCESS AND CONSULTATION

This proposal has been reviewed and approved by the Undergraduate Curriculum Committee, which is comprised of faculty representatives from each undergraduate program; undergraduate students; the Vice-Dean, Undergraduate Studies; the Chair of First Year; the Associate Dean, Cross-Disciplinary Programs; and the Registrar. The Committee meets regularly and reviews changes to the undergraduate curriculum.

RECOMMENDATION AND MOTION FOR FACULTY COUNCIL

> THAT the proposed major curriculum changes to the first year Core 8 and Track One programs for the 2015-2016 academic year be approved.

APS 101: Orientation to Engineering
First Year Seminar Course

Motivation:

This course is designed to augment the first-year student experience within the Core 8 and Track One programs by helping students to develop a greater understanding of the academic learning environment, the field of engineering, and how engineers think. One of the consistent themes from student feedback on the first year program relates to how they would like to have had a greater sense of what engineering is really like, what engineers do, and how the fundamental mathematics and sciences are used in an engineering context. As well, students often comment that they wish they had more support in making the transition in learning from high school to university.

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Learning Outcomes:

Upon completing this course, students will be able to:

- Formulate personalized detailed strategies to support engineering student success,
- Identify core competencies for success in engineering studies and engineering professional practice,
- Define academic integrity and how it applies to their first-year course experience
- Define a problem and formulate a methodology to solve the problem,
- Demonstrate the importance of the core first-year engineering curriculum in engineering education,
- Describe how engineers use math and science to solve real-world problems, and
- Describe math and science applications to engineering problems and engineering careers.

Course Design:

The key element within the course design is to enable students to individually integrate the course material through the use of reflective exercises and active learning strategies.

The course will consist of 6 (bi-weekly) 1 hour lectures and 13 weekly 1 hour tutorials. The lectures will be designed to be interactive and provide significant time for the students to engage with and consider the topic for that week. The lectures will be delivered by the Chair, First Year, First Year Office staff, and guest speakers (including faculty and alumni). It is proposed that three lecture sections be created, for a cohort size of approximately 330 students.

The class will be split into tutorials with around 30 students each (about 35 sections). These weekly tutorials will allow the students to place some of the lecture content in its appropriate context through guided individual and group exercises. These tutorials will be led by trained upper-year student

mentors. These upper-year undergraduate mentors will receive a minimum of 10 hours of training prior to the start of the course.

Students will be graded on the completion of a set of assessments. Numerical grades will be assigned on completed work, but students will receive a notation on their transcript for the completion of the course, rather than a numerical grade. This means this will not affect their program promotion or sessional or cumulative GPA. However, the course would have to be repeated at the next available offering if the student receives a failing grade. The grade notation scheme will consist of:

Fail (F) 0 – 59%
Pass (P) 60% - 79%
Honours (H) – 80% - 100%

Proposed Course Assessment:

- Class Attendance: 15%
- Tutorial Participation: 25%
- Term Work: 25%
- Final Test: 30%
- Course Feedback: 5%

Final Test:

- It is proposed that this 50 minute test would take place in the final tutorial or near the end of the term and cover applications of math and science to engineering problems, ethics in an academic context and engineering disciplines and career opportunities. The format will be multiple choice with a short answer component.

Resources:

- Teaching team of the Chair of First Year, First Year Office staff, and upper-year undergraduate students
- Guest speakers
    - Faculty
    - Alumni
    - Engineering professionals
    - Departmental liaisons

Ongoing Development and Workload:

Over the course of Summer 2015, the course content, delivery, and assessment plan would be further developed by a group of first, second, and third year students in collaboration with the First Year Office. The intent of this collaborative effort would be to create a course that would provide a high-value experience given the expected time investment in the course.

With the addition of this course, APS150: Ethics in Engineering would also be removed from the first-year curriculum. While this will afford a modest reduction in student workload, additional efforts will be made to reduce the workload within the fall term first year courses. It is also expected that the effort put into the course will enable students to be more effective and efficient in completing their other course work.

Course Topics:

The following topics will be covered in the course through both lecture and seminar tutorial. Each theme will be incorporated into two lectures within the course. The detailed topics are organized according to the weeks of the term.

Theme 1: Introduction to the Engineering Academic Environment

1. **Introduction to the Faculty of Applied Science & Engineering**
    a. Students will be able to:
        i. Describe the departmental and academic units of the Faculty of Applied Science and Engineering
        ii. Identify institutional resources and support
        iii. Articulate expectations associated with being an engineering student

2. **Course Structures and Assessment**
    a. Students will be able to:
        i. Describe the various forms of assessment common to their courses and explain their purpose
        ii. Identify instructional environments and learning tools they will encounter in their academic program
        iii. Define academic integrity and how it applies to their first-year course experience

3. **Academic Skills: Time Management**
    a. Students will be able to:
        i. Develop a time management action plan for their first semester
        ii. Demonstrate time management strategies and tools
        iii. Identify personal challenges associated with time management and ways to overcome them

4. **Academic Skills: Preparing for and Writing Tests and Exams**
    a. Students will be able to:
        i. Develop a plan for study in preparation for writing tests and exams
        ii. Recognize personal challenges associated with writing tests
        iii. Identify practices and habits that contribute to test-writing success
        iv. Formulate a personalized approach to exam writing
        v. Explain how the Code of Behaviour on Academic Matters relate to the writing of tests and exams at the University of Toronto

5. **Academic Skills: Problem Solving**
    a. Students will be able to:
        i. Clearly identify the problem from a problem statement
        ii. Interpret a problem solving model and its application
        iii. Formulate a solution plan (methodology) for solving a problem

Theme 2: How do Engineers Think?

6. **First Year Curriculum**
    a. Students will be able to:
        i. Describe the first-year curriculum in Engineering at U of T
        ii. Demonstrate the value of course topics
        iii. Explain the relevance of core course topics to the engineering field

7. **Math & Science Applications in Engineering**
    a. Students will be able to:
        i. Demonstrate the purpose of studying core math and science concepts in engineering
        ii. Identify real-world engineering applications of core math and science subjects
        iii. Describe how first-year course content relates to an engineering problem

8. **Curriculum in Action**
    a. Students will be able to:
        i. Describe how engineers use math and science to solve real-world problems
        ii. Demonstrate the impact of the first-year curriculum using a real-world example
        iii. Identify applications of first-year course content

Theme 3: Engineering Disciplines and Career Opportunities

9. **APSC Departments & Disciplines I and**
10. **APSC Departments & Disciplines II**
    a. Students will be able to:
        i. Identify the academic programs and pathways within the Faculty of Applied Science and Engineering
        ii. Describe the topics and areas of focus within each discipline
        iii. Demonstrate how their academic program aligns with their personal goals

11. **Careers in Core 8 I and**
12. **Careers in Core 8 II**
    a. Students will be able to:
        i. Identify engineering careers associated with engineering disciplines
        ii. Describe how the skills engineers develop are associated with particular careers
        iii. Describe how ethics is applied to the engineering profession
        iv. Demonstrate how their academic program aligns with career pathways of interest

13. **Leadership Skills**
    a. Students will be able to:
        i. Define leadership in the engineering context
        ii. Identify their leadership strengths
        iii. Formulate a plan to develop their leadership skills