



MEMORANDUM

To: Executive Committee of Faculty Council (February 4, 2020)
 Faculty Council (February 28, 2020)

From: Professor Julie Audet
 Chair, Engineering Graduate Education Committee (EGEC)

Date: February 13, 2020

Re: **EGEC Information Update**

REPORT CLASSIFICATION

This is a routine or minor policy matter that has been approved by the Engineering Graduate Education Committee on behalf of Faculty Council¹. It will be considered by the Executive Committee for endorsing and forwarding to Faculty Council for information.

NEW COURSES APPROVED

AER1517	Control for Robotics
APS2000	Summer Engineering Practicum
MSE1063	Application of Artificial Intelligence in Process Metallurgy
MSE1064	Extraction, Production and Processing of Aluminum
MSE1065	Application of Artificial Intelligence in Materials Design

MINOR MODIFICATIONS

MSE1043 Polymer and Composite Materials	Course name changed to “Composite Materials Engineering”
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¹ As a result of the 2005 Task Force on Graduate Education at the University of Toronto, EGEC has delegated authority to “consider and approve on behalf of Faculty Council and/or recommend to Faculty Council and/or SGS, matters relating to graduate curriculum, policy, new initiatives, program and course changes”.

MINOR MODIFICATIONS, CONTINUED

<p>MEng Emphasis in Analytics (CHE, CIV, ECE, MIE)</p>	<ol style="list-style-type: none"> 1. Make the Emphasis in Analytics available to MEng students in Materials Science & Engineering (MSE) 2. Expand the list of eligible core courses by adding <i>MSE1065 Application of Artificial Intelligence in Materials Design</i> and by moving <i>CHE1147 Data Mining in Engineering</i> from the list of elective courses to the list of core courses. This will create a third and fourth choice in the list of core courses for the Emphasis in Analytics. 3. Add <i>MSE1063 Application of Artificial Intelligence in Process Metallurgy</i> in the list of electives for the emphasis (with an exclusion for those who have taken <i>MSE1065</i> and <i>vice versa</i>)
<p>MEng, MASC, PhD Emphasis in Robotics and Mechatronics (AER, ECE, MIE)</p>	<ol style="list-style-type: none"> 1. Change the name to “Emphasis in Robotics” 2. Expand and update list of eligible courses based on several new offerings added since the emphasis was first conceived. Also, eliminate courses that have become less relevant to the revised emphasis or are no longer offered.
<p>MEng (CHE)</p>	<p>Create two new emphases:</p> <ol style="list-style-type: none"> 1. Emphasis in Biomanufacturing 2. Emphasis in Advanced Soft Materials <p><i>See Appendix 1</i></p>

RECOMMENDATION FOR FACULTY COUNCIL

For information.

University of Toronto

Minor Modification Proposal

Change to an Existing Graduate Program or Collaborative Specialization

This template should be used to bring forward all proposals for minor modifications to program or admissions requirements for existing graduate programs or collaborative specializations under the University of Toronto's Quality Assurance Process.

Program/Collaborative Specialization being modified:	MEng in Chemical Engineering
Graduate unit:	Chemical Engineering & Applied Chemistry
Faculty/academic division:	Applied Science & Engineering
Dean's office contact:	Julie Audet, Vice-Dean Graduate Studies
Version date:	February 13, 2020

1 Summary

	Changing admission requirements		Renaming field, concentration or emphasis*
	Changing program requirements		Renaming of program or collaborative specialization (please notify VPAP before governance)
	Changing timing of program requirements	X	Creating a new emphasis
			Changes to programs affecting an MOA
Summary: MEng students in the Department of Chemical Engineering & Applied Chemistry can earn emphases in the areas of Biomanufacturing and Advanced Soft Materials by completing four courses from the respective lists described in Appendix A.			

* Anything with a changed/new name requires consultation with VPAP Office prior to governance; if name change implies significant change to what is being offered or how it is being offered, this may be a major modification or new program.

2 Effective Date of Change

May 1, 2020

3 Academic Rationale

There is significant research expertise in the Faculty in biomanufacturing and advanced soft materials. However, the graduate course offerings in these areas are not linked well enough to form a cluster of courses that will enable the creation of corresponding MEng emphases. Graduate courses including a laboratory component were developed to train graduate students in these cutting-edge areas and to assemble these graduate courses into emphases. Furthermore, these carefully constructed and focussed emphases will enable students to achieve expertise in the technical skills that are crucial in the associated industry sectors. We expect that these emphases will improve the graduate student experience and enable the creation of strong linkages with industries in this sector through their involvement in curriculum development, teaching and potential graduate internships. It will also bring together professors across the different FASE departments in these areas and further strengthen interactions between researchers.

3.1 Emphasis in Biomanufacturing

CHE and IBBME have strong research programs in bioengineering (e.g. BioZone, CCRM) with various research projects ranging from biofuels and biochemical production, bioproducts from biomass, microbes for bioremediation, and applications in biomaterials, therapeutics, drug delivery and medicine. Additionally, infrastructure for bio manufacturing in terms of bioreactors, separation units (e.g. centrifuges and filtration), and analytical equipment (mass spec facility at BioZone, OCCAM), etc. are available within the departments. This emphasis will be distinct from the Masters in Biotechnology program at UTM given the strong focus on engineering and quantitative perspective in this curriculum. Through preliminary discussions with various stakeholders such as students, faculty and local industry (Sanofi Pasteur, Apotex Pharma (both based in the GTA), Ecosynthetix, Origin Materials), we have identified the following courses as being key for the Biomanufacturing emphasis. We expect that participating students would take four courses from the following list. Students will be permitted to double count at most one course towards other CHE & FASE emphases.

Appendix 1

Code	Title	Current/Proposed Instructor	Pre-Requisites	Lab	Frequency
CHE1133	Bioprocess Engineering: Fermentation, Cell culture, Bioreactor design, Theory and Laboratory Course, Bioseparations	TBD/Milica Radisic	JCC1313	Yes	Annual
JCC1313	Environmental Microbiology	Elizabeth Edwards			Annual
BME1459	Protein Engineering	Kevin Truong			Once in two years
CHE1123	Liquid Biofuels	Brad Saville			Once in two years
BME1480	Experimental Design and Multivariate Analysis in Bioengineering	Julie Audet			Once in two years
CHE1135*	Regulatory Affairs for Biotechnology and Biopharmaceutical Products: Analysis of regulations underlying therapeutics, renewable chemicals, environmental consortia, and other bioproducts.	TBD			Annual
CHE1334	Organ on a Chip: On-chip engineering of heart, kidney, cancer, vasculature and liver, Regulatory issues	Milica Radisic			Once in two years
JTC1331	Biomaterials	Milica Radisic			Once in two years

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CHE1125	Modeling & Optimization in Biochemical Networks	Radhakrishnan Mahadevan			Once in two years
CHE1134	Advances in Bioengineering	Emma Master			Once in two years

3.2 Emphasis in Advanced Soft Materials

Similarly, CHE, MSE and MIE have several researchers in the area of polymers, composites, colloids and suspensions. The emphasis in Advanced Soft Materials will focus on the fundamental aspects of soft materials such as the study of their underlying chemical and physical properties including their processing and synthesis, and the introduction of design principles for the engineering of soft materials for practical applications. We anticipate that this relatively narrow focus will make this emphasis unique in our Faculty and be attractive to students. We expect that participating students would take four courses from the following list. Two new courses will be introduced: a course focussed on colloids and formulation (Applied Colloid Science) and a course focussed on nanomaterials and biological entities (Nano-Biomaterials). Students will be permitted to double count at most one course towards other CHE & FASE emphases.

Code	Title	Current/Proposed Instructor	Pre-Requisites	Lab	Frequency
CHE562	Applied Polymer Chemistry	Jennifer Farmer			Annual
CHE1310	Chemical Properties of Polymers	Molly Shoichet	CHE562		Annual
JTC1134	Applied Surface and Interface Science	Edgar Acosta			Once in two years
JTC1135	Applied Surface and Interface Analysis	Jun Nogami			Once in two years
CHE1335*	Applied Colloid Science (New Course)	Edgar Acosta/ Arun Ramchandran	JTC1134		Once in two years
CHE1333*	Nanobiomaterials (New Course)	Frank Gu		Yes	Annual
CHE1475	Biocomposite Materials	Ning Yan			Annual

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MIE1705	Thermoplastics Polymer Processing	Patrick Lee			Annual
MIE1706	Manufacturing of Cellular and Microcellular Polymers	Chul Park			Once in two years
MIE1707	Structure Property Relationships of Thermoplastic and Composite Foams	Chul Park			Once in two years
MIE1740	Smart Materials and Structures	Hani Naguib			Annual
MSE1038	Computational Materials Design				
MSE1043	Composite Materials Engineering (name change pending)				

We anticipate that JTC1134 and MIE1707 will be offered in odd years and that JTC1135 and MIE1706 will be offered in even years. CHE562 will be a pre-requisite for CHE1310 and JTC1134 will be a pre-requisite for the CHE1335 course. These 12 courses will be the basis for this MEng emphasis.

4 Impact on Students

Students eligible for one of these emphases can, at the end of their program, earn the emphasis by requesting the notation on their transcripts to the CHE graduate office.

5 Consultation

The genesis of these emphases was based on a Dean's strategic fund grant. The course list for Advanced Soft Materials was sent to MIE/MSE in May 2019 and the Biomanufacturing course list was sent to IBBME in June 2019, as some of the eligible

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courses are offered outside CHE . The proposal was discussed at the Graduate Studies Committee meeting in May 2019 and the CHE faculty meeting in June 2019. The Vice-Dean, Graduate Studies was also consulted in May 2019. EGEC approved these two emphases in February 2020.

6 Resources

There are minimal resource implications as major increases in enrolment are not expected for any of the eligible courses listed given the significant number of them. A departmental or faculty administrator with access to ROSI will be responsible for verifying that students have completed the required courses and for adding the emphasis notation on their transcripts.

7 Governance Approval

Unit sign-off	CHE Graduate Curriculum Committee (June 19, 2019)
Dean's office sign-off	Julie Audet, Vice-Dean, Graduate Studies (January 30, 2020)
Faculty/division council approval (or delegated body) if applicable	Engineering Graduate Education Committee (EGEC) on behalf of the Council of the Faculty of Applied Science & Engineering (February 3, 2020)

Appendix 1

Appendix A: Calendar Entry

Please use track changes to indicate where changes have been made.

Emphasis: Biomanufacturing (MEng only)

MEng students must successfully complete any four half courses (2.0 full-course equivalents [FCEs]) from the following list:

CHE1123, CHE1125, CHE1133, CHE1134, CHE1135, CHE1334, JCC1313, JTC1331, BME1459, BME1480

Students may double-count one course at most towards any CHE emphasis, or towards any other emphasis in the Faculty.

Emphasis: Advanced Soft Materials (MEng only)

MEng students must successfully complete any four half courses (2.0 full-course equivalents [FCEs]) from the following list:

CHE562, CHE1310, CHE1333, CHE1335, CHE1475, JTC1134, JTC1135, MIE1705, MIE1706, MIE1707, MIE1740, MSE1043

Students may double-count one course at most towards any CHE emphasis, or towards any other emphasis in the Faculty.