UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

Report No. 3543

MEMORANDUM

To: Executive Committee of Faculty Council (March 21, 2017)
Faculty Council (April 10, 2017)

From: Professor Markus Bussmann
Chair, Engineering Graduate Education Committee

Date: March 17, 2017

Re: Adding Part-Time Option to IBBME's MEng Program

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).

RATIONALE FOR CHANGE

The Institute of Biomaterials & Biomedical Engineering (IBBME) proposes to add a part-time option to its MEng program. Currently, students can only register for the full-time MEng; however there has been applicant pressure for a part-time option.

This change will enable those who are currently employed full-time to complete the MEng degree, and will make it possible for eligible students who are currently registered in other programs or outside FASE to enrol in the MEng program.

PROCESS AND CONSULTATION

The attached proposal was drafted and approved by the Institute of Biomaterials & Biomedical Engineering (IBBME), with input from the Dean's Office. It has been approved by the Engineering Graduate Education Committee, which includes the graduate chairs from graduate departments and institutes, and graduate student representatives.

PROPOSAL FOR COUNCIL

THAT a part-time option be added to the Master of Engineering (MEng) program in the Institute of Biomaterials & Biomedical Engineering, as described in Report 3543, effective September 2017.

University of Toronto
Major Modification Proposal: Significant Modifications to Existing Graduate and Undergraduate Programs

Program Being Modified:	Master of Engineering (M.Eng.)
Proposed Major Modification:	Add a part-time option to program
Department/Unit:	Institute of Biomaterials & Biomedical Engineering (IBBME)
Faculty/Academic Division:	Faculty of Applied Science & Engineering (FASE)
Dean's Office Contact:	Markus Bussmann, Vice-Dean, Graduate Studies
Proponent:	Julie Audet, Associate Professor & Associate Director, Graduate Programs, IBBME
Version Date:	March 13, 2017

1 Summary

The goal of this proposal is to add a part-time option to the M.Eng. program offered by IBBME. Currently, students can only register for the full-time M.Eng.; however there has been applicant pressure for a part-time option. The program total FCE requirement is 5.0. In the full-time option, this 5.0 FCE has to be completed within three full-time sessions (in the first and second sessions, the students take courses and, in the third session, the students complete a 1.5 FCE internship).

In the part-time option, the FCE requirements and the degree level expectations and learning objectives of the program would remain the same (see Appendix A), but students would take only one or two courses (0.5 FCE) per session and the internship requirements would be completed over a period of one year. Therefore, the students will require more than two years to complete the program. Typically, part-time students would complete 1.5 FCE in year 1, 2.0 FCE in year 2 and 1.5 FCE in year 3.

2 Effective Date

September 2017

3 Academic Rationale

The availability of a part-time option in the M.Eng. will make it possible for those who are currently employed full-time to complete the M.Eng. degree. About a third of the successful applicants to the full-time program either deferred their admission to the following year or declined the admission offer. These students justified their decision based mainly on their reluctance to leave their current employment and their concerns with potential financial strain. Therefore, part-time studies would be an attractive alternative for these students. This change will also make it possible for eligible students who are currently registered in other programs or outside FASE to enrol in the M.Eng. (as described in section 6.1.14 of the SGS Calendar on Simultaneous Registration).

This part-time option is expected to raise the interest of current professionals in the biomedical industry for the M.Eng. program and, consequently, promote linkages with industry as well as cross-faculty interactions among classmates. This will enrich, in particular, the learning experience in the two core courses for this program (BME1800: Biomedical Product Development I, and BME1801: Biomedical Product Development II) by exposing both part-time and full-time students to varied points of views. This in turn will strengthen their ability to comprehensively assess complex problems, one of the current learning objectives of this M.Eng. program (see Appendix A).

4 Description of the Proposed Major Modification

The part-time students will be reallocated in terms of graduate spaces. The enrolment projections have also been adjusted based on actual enrolments, consideration of administrative resources required for identifying and developing internship placements and the optimum class size (around 25) for the core courses in year 1 (BME1800 and BME1801). Initially a total of 50 full-time students were expected to be in the program at steady-state (2020-2021); this has been revised to 10 full-time and 45 part-time students (23.5 FTE). In terms of intake, the projections from 50 new students per year have been decreased to approximately 25. The full-time option is expected to continue to include an equal proportion of international and domestic students while the part-time option would be mostly (80%) selected by domestic students.

Year in program	**2017-18**		**2018-19**		**2019-20**		**2020-21**		**2021-22**	
	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT
1	10	10	10	15	10	15	10	15	10	15
2	0	0	0	10	0	15	0	15	0	15
3	0	0	0	0	0	10	0	15	0	15
Total	10	10	10	25	10	40	10	45	10	45

5 Impact of the Change on Students

See Section 3.

6 Consultation

Broad consultation has been held with the IBBME Director (C. Yip); IBBME Associate Director, Graduate Programs (J. Audet); FASE Dean (C. Amon); FASE Vice-Dean, Graduate Studies (M. Bussmann); Faculty of Medicine Dean (T. Young); Foundations, MD Program Director, Faculty of Medicine (M. Law); and Translational Research Program Director, Institute of Medical Science, Faculty of Medicine (J. Ferenbok).

7 Resources

For the two core courses (BME1800 and BME1801), part-time students will be in the same classes as full-time students. These courses will be offered late afternoon or evenings to accommodate working professionals. It is expected that a few others BME courses will also be offered late afternoon or evenings. A new course code will be created for the Internship in Applied Research (1.5 FCE) which will span three sessions (BME1898Y). The students in the program can also select a large number of engineering, science and commercialization courses outside IBBME (as long as they are approved by the Program Director) and many of these courses are available as late afternoon or evening classes. Students who have applied to the part-time option of the program will be advised in their letter of admission offer to take into account the fact that only a subset of courses are available outside regular work hours and they will be encouraged to submit a curriculum plan to the Program Director before the start of the program.

8 UTQAP Process

Steps	**Dates**
Development/consultation within unit (IBBME)	Feb 2017
Consultation with Faculty of Applied Science & Engineering Dean's Office and Office of Vice-Provost, Academic Programs	Feb-Mar 2017
Unit level approval as appropriate	Mar 2017
Engineering Graduate Education Committee (EGEC) approval as appropriate	Mar 2017
Faculty Council approval	Apr 2017
Submission to Office of Vice-Provost, Academic Programs	Apr 2017

Reported annually to Committee on Academic Policy & Programs (AP&P)	May 2017
Reported annually to Ontario Quality Council	Jul 2017

Appendix A: Current Learning Outcomes, and Degree Level Expectations

In the part-time option, the FCE requirements, degree level expectations and learning objectives of the program will remain the same as the full-time option.

Master of Engineering Degree Level Expectations *(Approved by FASE Council in March 2011)*	**Program Learning Outcomes**	**How the program design / structure supports the attainment of the Degree Level Expectations and Program Learning Outcomes**
EXPECTATIONS: ***The Master of Engineering in Biomedical Engineering is awarded to students who have demonstrated:***		
1. Depth and Breadth of Knowledge A systematic understanding of engineering and applied science knowledge including, where appropriate, relevant knowledge outside the field and engineering discipline, and a critical awareness of current problems and/or new insights, much of which is at, or informed by, the forefront of their engineering or applied science discipline.	Depth and breadth of knowledge is defined in the M.Eng. in BME program as expertise in at least one field of biomedical engineering and an understanding of the challenges of moving technology forward in a regulated environment. This is reflected in students who are able to: • Apply mathematics, life sciences, physical sciences, and engineering to biomedical device development (e.g. to develop a concept for a device and a design a prototype). • Appreciate potentially conflicting interests or points of view (patients, physicians and business persons).	The program design and requirement elements that ensure these student outcomes for depth and breadth of knowledge are: • Coursework in engineering, biomedical sciences and entrepreneurship. • A core entrepreneurship course which will be a survey course that will cover a variety of technologies and applications. Captured in the internship where students will cover four important aspects of biomedical device development (need assessment, concept development, design and prototype, business models).
2. Knowledge of Methodologies A conceptual understanding and methodological competence that: (a) Enables a working comprehension of how established techniques of inquiry are used to interpret knowledge in the discipline.	Knowledge of methodologies is defined in the M.Eng. in BME program as a conceptual understanding and methodological competence that: • Enables a working comprehension of how experimental methods and data analysis methods can be	The program design and requirements that ensure these student outcomes for knowledge of methodologies are: • Outstanding instructors whose expertise will bring both theory and practice to the classroom. • Course papers and case studies

Master of Engineering Degree Level Expectations *(Approved by FASE Council in March 2011)*	**Program Learning Outcomes**	**How the program design / structure supports the attainment of the Degree Level Expectations and Program Learning Outcomes**
(b) Enables a critical evaluation of current developments in the discipline. (c) Enables a treatment of technical issues and judgments based on established principles and techniques.	used to assist the design of biomedical devices and optimize them. • Enables a critical evaluation of current developments in the at least one field of study at IBBME and familiarity with viewpoints of experts in other disciplines (e.g. medicine and business). • Enables a treatment of technical issues and judgments based on principles of engineering designs and method of data analysis. This is reflected in students who are able to: • Develop a concept for a medical device based on literature and patent searches, input from experts. • Consider and evaluate the validity of the assumptions on which the device concept is based. • Critically and comprehensively assess a complex problem from the viewpoints of stakeholders. • Distinguish between what is known and what is unknown and subsequently elaborate a research plan that will shed light on the unknown. • Evaluate a biomedical device design strategy and identify areas where alternative or better approaches could be used, to consider and evaluate cost-effectiveness.	for the Engineering, Commercialization and Entrepreneurship, and Biomedical Sciences, where students will have the opportunity to explore in-depth topics. • Captured in the internship where students will cover four important aspects of biomedical device development (need assessment, concept development, design and prototype, business models).
3. Level of Application of Knowledge Competence in the application of	Level of application of knowledge is defined in the M.Eng. in BME program as the ability to identify	The program design and requirements that ensure these student outcomes for level and

Master of Engineering Degree Level Expectations *(Approved by FASE Council in March 2011)*	**Program Learning Outcomes**	**How the program design / structure supports the attainment of the Degree Level Expectations and Program Learning Outcomes**
an existing body of data in the critical analysis of advanced problems or issues. Here, advanced indicates a difficulty level beyond that encountered at the undergraduate level.	areas where engineering can be used to innovate and solve problems in medicine and develop a plan to achieve this goal. This is reflected in students who are able to: • Proficiently identify, formulate, and solve advanced biomedical engineering problems. • Use advance techniques, skills, and modern engineering tools necessary for to develop a design and prototype for a new biomedical device. • Distinguish between what is known and what is unknown and elaborate a research plan that will shed light on the unknown. • Proficiently design and validate experiments, systems, components or processes to meet desired needs. • Develop a concept for a biomedical device based on literature and patent searches, input from experts. • Critically assess a complex problem with opposite and conflicting perspectives.	application of knowledge are: • Exams and projects in the Biomedical Engineering Technology, Commercialization and Entrepreneurship, and Biomedical Sciences pillar courses. • Captured in the internship where students will cover four important aspects of biomedical device development (need assessment, concept development, design and prototype, business models). • Captured in the internship where students are expected to achieve significant advances in biomedical device prototyping.
4. Professional Capacity/Autonomy (a) The qualities and transferable skills necessary for employment requiring: i. The exercise of initiative and of personal responsibility and accountability. ii. Decision-making in complex situations.	Professional capacity/autonomy is defined in the M.Eng. in BME program as the ability to translate ideas into commercial realities. This is reflected in students who are able to: • Prepare research papers and practicum reports. • Integrate professional, social, ethical and environmental	The program design and requirements that ensure these student outcomes for professional capacity/autonomy are: • Individual exams in the Engineering Technology, Commercialization and Entrepreneurship, and Biosciences pillar courses. • Evaluation of internship report (quality of research proposal,

Master of Engineering Degree Level Expectations *(Approved by FASE Council in March 2011)*	**Program Learning Outcomes**	**How the program design / structure supports the attainment of the Degree Level Expectations and Program Learning Outcomes**
(b) The intellectual independence required for continuing professional development. (c) The ethical behaviour consistent with academic integrity and the use of appropriate guidelines and procedures for responsible conduct in a professional context. (d) The ability to participate meaningfully as leaders in society.	considerations in to their decision analysis. • Display proficient contemporary technical and scientific comprehension and lifelong learning. • Complete the degree requirements in a timely manner. • Demonstrate project management skills. Revise plans and adapt to the unexpected.	research design and innovation and conclusions). • Course papers and case studies for the core Commercialization and Entrepreneurship courses where students will have the opportunity to explore in-depth topics (specifically in the Regulatory Requirements Module and the Biomedical Engineering Ethics Module). • Independent work in the internship.
5. Level of Communications Skills The ability to communicate ideas, issues, and conclusions clearly in oral and written form. This includes being capable of constructing a credible argument and presenting it in appropriate formats.	Level of communications skills is defined in the M.Eng. in BME program as an ability for proficient technical and scientific communication. This is reflected in students who are able to: • Construct a credible argument and present it in appropriate formats. • Generate research and position papers. • Make professional presentations. • Condense complex topics and analyses into simple and easily communicated messages for a diverse set of stakeholders.	The program design and requirements that ensure these student outcomes for level of communication skills are: • Course papers and case studies for the Biomedical Technology, Commercialization and Entrepreneurship, and Medical Sciences, where students will have the opportunity to explore in-depth topics. • Internship report.
6. Awareness of Limits of Knowledge Cognizance of the complexity of knowledge, its underlying assumptions, and the potential contributions of other interpretations, methods, and disciplines.	Awareness of the limits of knowledge is defined in the M.Eng. in BME program as cognizance of the complexity of knowledge, its underlying assumptions, and the potential contributions of other interpretations, methods, and disciplines. This is reflected in students who	The program design and requirements that ensure these student outcomes for level of awareness of limits of knowledge are: • Evaluation of internship report (quality of research proposal, research design and innovation and conclusions). For the

Master of Engineering Degree Level Expectations *(Approved by FASE Council in March 2011)*	**Program Learning Outcomes**	**How the program design / structure supports the attainment of the Degree Level Expectations and Program Learning Outcomes**
	are able to: • Critically assess a complex problem with opposite and conflicting perspectives (patients, physicians and business persons). • Prepare a research proposal (practicum) and develop a research plan. • Judge when it is necessary to consult experts in specific areas. • Recognize limitations of methods used (in medicine, engineering and business). • Envision areas for future work/research, or next steps in research and development.	internship report, one of the performance indicators used will be that the student has the ability to reflect on overall design strategy and has identified areas where alternative or better approaches could have been used, if applicable and the student has considered the validity of his/her assumptions.

Appendix B: Current Calendar Copy

Biomedical Engineering: Biomedical Engineering MEng

Master of Engineering

The MEng program is offered in the fields of 1) Biomaterials, Tissue Engineering and Regenerative Medicine; 2) Engineering in a Clinical Setting; 3) Nanotechnology, Molecular Imaging and Systems Biology; and 4) Neural/Sensory Systems Rehabilitation.

Admission Requirements

- Applicants are admitted under the General Regulations of the School of Graduate Studies. Applicants must also satisfy IBBME's additional admission requirements stated below.
- A bachelor's degree in engineering or equivalent from a recognized university with at least an average of A- in the final two years of study.

Program Requirements

- The program comprises at least 5.0 full-course equivalents (FCEs) as follows:
    - at least 1.0 FCE in biomedical engineering technology courses;
    - at least 1.0 FCE in commercialization and entrepreneurship courses including BME 1800H and BME 1801H;
    - at least 1.0 FCE in biomedical sciences courses;
    - a 1.5 FCE internship (BME 1899) in biomedical device development, usually over the summer session, in at least one of the following biomedical engineering research fields: 1) Neural/Sensory Systems and Rehabilitation; 2) Biomaterials, Tissue Engineering and Regenerative Medicine; 3) Nanotechnology, Molecular Imaging and Systems Biology; or 4) Engineering in a Clinical Setting. The internship can be taken in academic research laboratories, government institutions, health-care facilities, in the industry, or in health-care consulting firms.
    - the remaining 0.5 FCE can be a half course in either biomedical engineering technology, commercialization and entrepreneurship, or biomedical sciences.
- For the 5.0 FCEs, 2.5 FCEs must be BME courses (or a joint BME course with the designator JCB, JEB, JPB, JSB, or JMM); this includes the practicum project BME 1899Y. The remaining three courses (1.5 FCEs) can be taken from any other department associated with the program. All courses must be graduate level, which includes both 500- and 1000-level. Students can take a maximum of one 500-level course.

- A curriculum plan must be submitted to the program director prior to the start of the program.
- A written report submitted to the program director.
- Health and safety training workshops.
- Students in the MEng program have the option of completing an emphasis in Entrepreneurship, Leadership, Innovation and Technology in Engineering (ELITE) as part of their degree program. Please see details below.

Program Length

3 sessions full-time (typical registration sequence: F/W/S)

Time Limit

2 years full-time

Appendix C: Proposed Calendar Copy

Biomedical Engineering: Biomedical Engineering MEng

Master of Engineering

The MEng program is offered in the fields of 1) Biomaterials, Tissue Engineering and Regenerative Medicine; 2) Engineering in a Clinical Setting; 3) Nanotechnology, Molecular Imaging and Systems Biology; and 4) Neural/Sensory Systems Rehabilitation.

Admission Requirements

- Applicants are admitted under the General Regulations of the School of Graduate Studies. Applicants must also satisfy IBBME's additional admission requirements stated below.
- A bachelor's degree in engineering or equivalent from a recognized university with a minimum academic standing of A- in the final two years of study.

Program Requirements

- The program comprises at least 5.0 full-course equivalents (FCEs) as follows:
    - at least 1.0 FCE in biomedical engineering technology courses;
    - at least 1.0 FCE in commercialization and entrepreneurship courses including BME 1800H and BME 1801H;
    - at least 1.0 FCE in biomedical sciences course;
    - a 1.5 FCE internship ~~(BME 1899)~~ in biomedical device development, usually over one session for the full-time option (BME 1899), and over three sessions for the part-time option (BME 1898Y), in at least one of the following biomedical engineering research fields: 1) Neural/Sensory Systems and Rehabilitation; 2) Biomaterials, Tissue Engineering and Regenerative Medicine; 3) Nanotechnology, Molecular Imaging and Systems Biology; or 4) Engineering in a Clinical Setting. The internship can be taken in academic research laboratories, government institutions, health care facilities, in the industry, or in health care consulting firms;
    - the remaining 0.5 FCE can be a half-course in either biomedical engineering technology, commercialization and entrepreneurship, or biomedical sciences.
- For the 5.0 FCEs, 2.5 FCEs must be BME courses (or a joint BME course with the designator JCB, JEB, JBP, JSB or JMM); this includes the practicum project BME 1899 or BME1898Y. The remaining three courses (1.5 FCEs) can be taken from any other department associated with the program. All courses must be graduate level, which

includes both 500- and 1000-level. Students can take a maximum of one 500-level course.

- A curricular plan must be submitted to the program director prior to the start of the program.
- A written report submitted to the program director.
- Health and safety training workshops.
- Students in the MEng program have the option of completing an emphasis in Entrepreneurship, Leadership, Innovation and Technology in Engineering (ELITE) as part of their degree program. Please see details below.

Program Length

3 sessions full-time (typical registration sequence: F/W/S)
9 sessions part-time (typical registration sequence: F/W/S/F/W/S/F/W/S)

Time Limit

2 years full-time
6 years part-time