WELCOME

On behalf of the faculty and staff of the Institute of Biomaterials and Biomedical Engineering, we would like to extend a warm welcome to you. Whether you are new to the Institute or continuing in your graduate studies here at the University of Toronto, we hope that this handbook will be of assistance to you. We always welcome your comments and suggestions and look forward to assisting you throughout your graduate experience.

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1.0 REGISTRATION POLICIES AND PROCEDURES

Students registered as full-time students in the School of Graduate Studies must be engaged in their studies on a full-time basis, as required by government regulations for full-time graduate studies.

Full-time graduate students are defined according to government regulations as follows:

1. They must be pursuing their studies as a full-time occupation and identify themselves as full-time graduate students.
2. They must be designated by the University as full-time students.
3. They must be geographically available and visit the campus regularly.
4. They must be considered to be full-time students by their supervisors.
5. If an academic program requires an absence from the University, students must apply through their graduate unit for permission to be off campus.

A full-time student may be absent from the University for an extended period or may participate in a program offered by another university if, and only if, the student has received written permission from the graduate unit in which he or she is registered. A graduate student who, in a given session, is absent from the University without receiving prior approval may lose good academic standing. In exceptional cases, a graduate unit may recommend to the School of Graduate Studies the termination of the student's registration and eligibility.

1.1 Registering in your Program

Students must register annually, in September, for each year of the program. New students must have cleared all conditional offers of admission prior to registration by submitting a final official transcript reflecting final grades and evidence of degree conferral to the Institute.

The School of Graduate Studies sends all registration material to students between July and August. If you have not received this information by mid-August, you should contact the graduate unit.

The initial payment of academic and incidental fees will ensure the student is registered in the program. Payment of fees must be made through a Canadian bank, payable to the University of Toronto in Canadian funds. Failure to register as required will cause the student’s candidacy’s status to lapse.

The SGS website is the most up-to-date place to find information on registration, fees, and University of Toronto policy. One very important link you may wish to use is:

http://www.sgs.utoronto.ca/currentstudents/Pages/Graduate-Fees.aspx
1.2 Late Registration
Students are responsible for ensuring proper registration by the appropriate deadlines. Late registration will be subject to an additional fee as outlined by the School of Graduate Studies.

1.3 Dual Registration
Simultaneous registration in two different programs is not permitted without approval of the Institute and is not available for MASc students. PhD students can be considered for registration in more than one graduate program provided:

1) The second degree is conducted part-time;
2) The student completed their Qualifying Exam or By-pass into the PhD program;
3) The student has obtained written approval from their supervisor.

1.4 Deferred Payment of Fees
Fee deferrals allow students to register for the academic year without having to make a payment toward their academic fees. Once approved, your fees are deferred until April 30 of the current academic year. Students are still eligible to make payments toward fees during the deferral period, though they are not required to. Interest is charged on any outstanding balance as of May 1st and the full balance must be paid by August in order for registration to be approved for the next academic year. Students with an outstanding balance will not be permitted to register for the upcoming year if there is an outstanding balance.

Students may defer tuition fees directly on ROSI or by contacting the Graduate Office of the Institute or the collaborating departments if you are in the Collaborative Program. MHSc students must contact the Clinical Engineering Office in order to defer fees.

You may temporarily defer payment of fees if you receive one of the following:

- OSAP – fees can be deferred at SGS (with the exception of Management, OISE/UT, Social Work, and Information Studies who defer fees at their own department) when you present a Notice of Assessment covering at least the minimum first payment.
- University of Toronto Fellowships, OGS, OGSST, NSERC, SSHRC, CIHR, Connaught, Mary Beatty, TAS or RAS with full funding package – fees can be deferred at departments.
- U.S. Loans – fees can be deferred at Admissions and Awards.
- All other loans and awards – fees can be deferred at SGS.

2.0 FINANCIAL SUPPORT
The Institute’s annual stipend is $17,000 (for MASc students) and $18,500 (for PhD Students) + tuition + fees from September 1 to August 31. Additional awards are not considered a top-up to this amount. Should you subsequently receive an award or multiple awards, your total stipend would be adjusted accordingly, depending on type and amount of the awards. Financial support beyond your first year will be contingent upon your satisfactory performance.
A chart of minimum stipend amounts can be found on the IBBME website: http://www.ibbme.utoronto.ca/students/graduate/current/tuition/

You will be responsible for paying all tuition and fees to the School of Graduate Studies from the stipend mentioned above. Please take a moment to review Tuition and Fees on the IBBME website http://www.ibbme.utoronto.ca/students/graduate/prospective/tuition-fees-schedule/

**Domestic Students**

Domestic graduate students receive a minimum annual stipend during the BIU eligible years of their program. BIU eligibility is set by the Ministry of Education and is determined by the total number of years of graduate studies. PhD students who hold a Masters degree will have three years of BIU funding. Direct-Entry PhD and By-pass students will have five years of BIU eligibility available (equivalent to two years of Masters studies + three years of Doctoral studies).

The minimum annual stipend for each program is calculated as:

- MASc students: $17,000 + tuition + fees from September 1 to August 31
- PhD students: $18,500 + tuition + fees from September 1 to August 31
- MHSc students: tuition from September 1 to August 31

The IBBME Graduate Administrator will verify tuition and fees for the upcoming academic year with Student Accounts in order to correctly determine the minimum stipend amount in each year.

IBBME supplements domestic student stipends with fellowship support to aid the supervisor. Additional awards are not considered a top-up to this amount.

- MASc students will receive funding for two years of their program, but will only receive the IBBME fellowship in year one.
- PhD students, who already hold a Master’s degree, are guaranteed funding for four years of their program and will receive the IBBME fellowship for the first three years. Students are not guaranteed funding after year four, though some supervisors may continue to fully or partially fund their student.
- Direct-entry and By-pass PhD students are guaranteed funding for five years of their program and will receive the IBBME fellowship for the first four years. Students are not guaranteed funding after year five.
- Students holding major awards of $10k+ will not receive the IBBME fellowship and their supervisor will top up their award to meet the minimum stipend requirement.
International Students

International students receive a minimum annual stipend based on the following formula:

- MASc students: $17,000 + international tuition + fees from September 1 to August 31
- PhD students: $18,500 + international tuition + fees from September 1 to August 31
- MHSc Students: international tuition from September 1 to August 31

International students who obtain Permanent Resident status during their term as a full-time graduate student will only pay domestic student tuition and fees and may receive the IBBME fellowship support only if they fall within the BIU eligibility years; i.e: the student is in year three or less of their PhD program.

Students in the Collaborative Program will be funded following the policies of their home departments.

Fellowships and Awards

Students are strongly encouraged to apply for external scholarships. Canadian citizens and permanent residents may apply for federal scholarships from granting agencies such as the Natural Sciences and Engineering Research Council of Canada (NSERC), or the Canadian Institutes of Health Research (CIHR), or provincial programs such as the Ontario Graduate Scholarship Program (OGS). Students may also apply for the Queen Elizabeth II - Graduate Scholarship in Science and Technology (QEII-GSST). Although NSERC and CIHR scholarships are strictly reserved for Canadian citizens and permanent residents, OGS and QEII-GSST awards are available to international students with outstanding academic records. Some scholarships may be multi-year awards, in which case, it is the student’s responsibility to complete all necessary paperwork to allow continuation of his/her award.

For students registered in the Biomedical Engineering or the Clinical Engineering Programs, applications should be submitted to the IBBME Graduate Office. Students registered in the Collaborative Program should submit the application to their home departments.

Information pertaining to each of the above scholarships can be found at:

<table>
<thead>
<tr>
<th>Scholarship</th>
<th>Website</th>
<th>Deadline</th>
<th>Application</th>
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Information on other external scholarships can be found through the School of Graduate Studies (http://www.sgs.utoronto.ca/). Scholarship and fellowship opportunities are regularly announced by the Graduate Studies offices of both the Faculties of Engineering and Medicine. Students are strongly encouraged to consider these competitions.

A limited number of Teaching Assistantship positions are also available to students who are officially registered in degree program at the University. Information about the available positions is usually posted approximately one to two months prior to the beginning of each term on the IBBME website. All terms and conditions of employment are set out in the Collective Agreement between the Canadian Union Public Employees (CUPE Local 3902) and the Governing Council of the University of Toronto.

**Doctoral Completion Award**
The aim of the Doctoral Completion Award (DCA) is to provide support to full-time PhD students after their guaranteed graduate funding ends.

<table>
<thead>
<tr>
<th>Scholarship Name</th>
<th>Website</th>
<th>Application</th>
<th>Deadline</th>
<th>Notes</th>
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<tr>
<td>OGS</td>
<td><a href="http://www.sgs.utoronto.ca/currentstudents/Pages/Ontario-Graduate-Scholarship.aspx">http://www.sgs.utoronto.ca/currentstudents/Pages/Ontario-Graduate-Scholarship.aspx</a></td>
<td>Students will be notified Deadline is usually spring. Must be submitted to the Graduate Office.</td>
<td>April – May of each year. Students will be notified as it becomes available.</td>
<td></td>
</tr>
<tr>
<td>QEII-GSST</td>
<td></td>
<td></td>
<td></td>
<td>A maximum of two new awards are made to the incoming class. Only International PhD students are eligible to apply. On-going support through this program will be contingent on demonstrated performance in research and eligibility and availability of funds. Deadline for applications is May 1st and should be submitted by the supervisor.</td>
</tr>
<tr>
<td>IBBME International Fellowship Award</td>
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<tr>
<td>FOM OSOTF and Other Endowed Awards</td>
<td><a href="http://graduate-awards.knowledge4you.ca/graduateawards/awards.cfm">http://graduate-awards.knowledge4you.ca/graduateawards/awards.cfm</a></td>
<td>Deadline spring</td>
<td>Application submitted directly to Faculty of Medicine</td>
<td></td>
</tr>
<tr>
<td>CIHR CGS D</td>
<td><a href="https://www.researchnet-recherchenet.ca/rnr16/vwOpprtntyDtls.do?prog=2097&amp;view=currentOpps&amp;type=EXACT&amp;resultCount=25&amp;sort=program&amp;all=1&amp;masterList=true">https://www.researchnet-recherchenet.ca/rnr16/vwOpprtntyDtls.do?prog=2097&amp;view=currentOpps&amp;type=EXACT&amp;resultCount=25&amp;sort=program&amp;all=1&amp;masterList=true</a></td>
<td>Deadline Early Fall</td>
<td>Application must be submitted to the Graduate Office</td>
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Each DCA award is worth $6000 and covers one academic term.

To hold a DCA, a student must be in good standing and no longer be eligible for guaranteed graduate funding. In addition, they must pass their Departmental Doctoral Defense or Senate Final Oral Exam during DCA award term. A student can hold the DCA during a maximum of two consecutive terms and a student is no longer eligible to hold a DCA after all their PhD requirements have been met.

A PhD student should apply for the DCA before the beginning of the term in which they can start holding the DCA. Call for applications will occur in August, December and April. The DCA application must include a recent committee meeting report (i.e. the DCA application and the latest committee meeting should take place during the same term).

Applications for the DCA should be made to the Graduate Office in IBBME and should include a reference letter from the applicant’s supervisor confirming that the student meets (and will meet) all the conditions of the DCA award. Failure to meet the terms of the DCA award will require repayment of the award to IBBME.

3.0 GRADUATE PROGRAMS: REQUIREMENTS

3.1 The Biomedical Engineering Program – MASc
The Biomedical Engineering Program (BME) leading to the Master of Applied Science (MASc) degree provides an opportunity for students to pursue advanced research studies within the field of Biomedical Engineering.

The program requires full-time study, with students committed to completing the degree requirements within 18-24 months of registration. The program of study normally consists of four-half credit courses relevant to the thesis research and a research thesis completed under the guidance of a supervisor. A half-credit course is defined as one semester long (approximately thirteen weeks). Courses should be chosen in consultation with the thesis supervisor.

3.1.1 Required Courses
Graduate courses and seminars for the master’s degree program are:

- Four half-credit courses, one of which must be BME 1450H Bioengineering Science.
- Students with engineering or physical science backgrounds must take a life science course (See Appendix G and H for more information).
- Students with a life sciences background must take an engineering course (See Appendix G for more information).
- BME 1010Y Graduate Student Seminar Series (a minimum of eight seminars – six student seminars and two Distinguished Speakers seminars).
- IBBME Health & Safety Training Workshop, WHMIS, and Biohazard and Safety.
- Faculty of Engineering ‘Ethics in Research’ Seminar (JDE1000)
* If you are interested in taking graduate-level APS or ELITE courses, please be aware these courses will not fulfill the degree requirements of the Institute. You are strongly advised to consult with the graduate office prior to enrolling in these courses.

** Students are limited to one, 500 level course in fulfillment of degree requirements.

Other students, professors, your supervisor and the graduate coordinator can provide advice on course selection. Selected course descriptions can be found in Appendix B. It is recommended that MASc students complete their course requirements within the first year of registration.

3.1.2 Requirements Related to the Research Thesis
- Supervisory committee meetings, yearly or more frequently (see section 5.0)
- Completion of a research thesis (see Section 7.0)
- Departmental Thesis Defense (see Section 7.0)

3.1.3 Academic Standing and Satisfactory Progress

Students are expected to remain in good standing and show satisfactory progress in their research and in their coursework during their program. Students who fail to remain in good standing and show satisfactory progress may face termination of their registration in the program (see section 6.4).

3.2 Direct Transfer (Bypass) from MASc to a PhD

MASc students with excellent performance may be permitted to transfer (bypass) into the PhD program, under the same supervisor, after completing not more than fourteen months of their master’s degree program. Approval of transfer will be evaluated on the basis of the student’s advanced research capabilities, as well as academic standing. MASc students in the Biomedical Engineering Program who wish to transfer directly into the PhD program, and bypass the master’s thesis examination, are required to take a bypass examination (i.e. a PhD qualifying exam, see Section 5.3). If the candidate has spent more than fourteen months in an MASc program, they will be expected to complete their thesis at the master’s level and reapply to the PhD program. Students will be considered for bypass if they have a recommendation from their Master’s Committee and/or their supervisor and have maintained an A- average at the master’s level.

Student who successfully bypass in the PhD program will be subject to the degree requirements and timeline of Direct-Entry PhD students as outlined in Section 3.4. Students will be required to complete the coursework for both the MASc and PhD programs, a total of six courses. Upon transfer into the PhD program, students will be considered registered in year two of their PhD program.
3.3 The Biomedical Engineering Program – PhD
The Biomedical Engineering Program leading to the Doctor of Philosophy (PhD) degree is intended for students performing research at the most advanced level. Candidates for this degree program usually hold a master’s degree.

A program of study for students admitted into the PhD program (with a thesis-based Master’s degree in biomedical engineering) normally consists of two half-credit courses, a PhD Qualifying examination and the successful completion and defense of an extensive research thesis. All required courses should be completed within the first two years, and no more than four years should be needed to complete all degree requirements.

3.3.1 Course Requirements for the PhD Program
- Students who hold a master’s degree in Biomedical Engineering are required to take two half-credit courses relevant to their research, chosen in consultation with the thesis supervisor.
- Students who have completed a master’s degree outside the field of Biomedical Engineering will have to take from two to six half-credit courses, depending on the recommendation of their supervisory committee.
- Students with a life science background must take an engineering or physical science course. Students with an engineering or physical science background must take a life science course. (See Appendix G for more information).
- BME 1011Y Graduate Student Seminar Series.
- IBBME Health & Safety Training Workshop, WHMIS, and Biohazard and Safety.
- Faculty of Engineering ‘Ethics in Research’ Seminar (JDE1000)

* If you are interested in taking graduate-level APS or ELITE courses, please be aware these courses will not fulfill degree requirements of the Institute. You are strongly advised to consult with the graduate office prior to enrolling in these courses.

** Students are limited to one, 500 level course in fulfillment of degree requirements.

3.3.2 Requirements Related to the PhD Research Thesis
- Supervisory committee meetings, yearly or more frequently (see Section 5.0)
- Pass a PhD Qualifying Exam (see Section 5.3)
- Completion of a PhD research thesis (see Section 7.0)
- Departmental PhD Oral Examination (see Section 7.0)
- Final PhD Oral Examination (see Section 7.0)

3.3.3 Academic Standing and Satisfactory Progress
Students are expected to remain in good standing and show satisfactory progress in their research and in their coursework during their program. Students who fail to remain in good standing and show satisfactory progress may face termination of their registration in the program (see section 6.4).
3.3.4 Time-Line for Completing Degree Requirements

Doctoral students must complete all required course work within the first 3 years of their program in order to remain in good academic standing.

A doctoral student will be denied further registration in their program and will have their registration eligibility terminated at the end of the third year of registration if, by that time:

- The student has not completed all requirements for the degree exclusive of thesis (including course requirements, language requirements, PhD qualifying examinations); or
- The student does not have an approved thesis topic, supervisor, or supervisory committee.

Students must maintain satisfactory progress in their program and remain in good academic standing. Please see section 6.4 of the handbook for more information.

The notation, Candidacy Achieved, will appear on the transcript of the student who has completed all requirements for the degree exclusive of thesis. A student who has failed to achieve candidacy may be permitted to register in the program for up to 12 months, subject to approval by IBBME. To apply for an extension, the student must complete the Extension to Achieve Candidacy form and present to the graduate unit concerned the causes for the delay and evidence that the remaining candidacy requirements will be completed within the period of the extension requested. The completed Extension to Achieve Candidacy form and all supporting documents for the extension must be filed at the graduate unit. A copy of the completed Extension to Achieve Candidacy form must be submitted to SGS for processing before the deadline to achieve candidacy.

Please see Appendix F for course details.

3.4 Direct Entry and By-pass PhD Program Requirements

The Direct-entry Doctor of Philosophy (PhD) degree is intended for students who are able to perform research at the Doctoral level directly from their Undergraduate degree. (see section 3.2)

3.4.1 Course Requirements for the PhD Program

- Six half courses, or three full-course equivalents (FCE), relevant to the thesis research, chosen in consultation with their supervisor. These include the four half courses that would have been completed at the Master’s level, or six half courses required for the MHSc, as well as the two half course required for PhD.
- Students with a life sciences background must take an engineering course. Students with an engineering or physical science background must take a life science course. (See Appendix G for more information).
- BME 1011Y Graduate Student Seminar Series.
- IBBME Health & Safety Training Workshop, WHMIS, and Biohazard and Safety.
- Faculty of Engineering ‘Ethics in Research’ Seminar (JDE1000)
*If you are interested in taking graduate-level APS or ELITE courses, please be aware these courses will not fulfill the technical degree requirements of the Institute. You are strongly advised to consult with the graduate office prior to enrolling in these courses.

**Students are limited to one, 500 level course in fulfillment of degree requirements.

3.4.2 Requirements Related to the PhD Research Thesis
See section 3.3.2

3.4.3 Academic Standing and Satisfactory Progress
See section 3.3.3

3.4.4 Time-Line for Completing Degree Requirements
Direct entry and By-pass Doctoral students must complete all required course work within the first 4 years of their program in order to remain in good academic standing.

A direct-entry doctoral student will be denied further registration in their program and will have their registration eligibility terminated at the end of the fourth year of registration if, by that time:

- The student has not completed all requirements for the degree exclusive of thesis (including course requirements, language requirements, PhD qualifying examinations); or
- The student does not have an approved thesis topic, supervisor, or supervisory committee.

Students must maintain satisfactory progress in their program and remain in good academic standing. Please see section 6.4 of the handbook for more information.

The notation, Candidacy Achieved, will appear on the transcript of the student who has completed all requirements for the degree, exclusive of thesis. A student who has failed to achieve candidacy may be permitted to register in the program for up to 12 months provided that the graduate unit concerned approves. To apply for an extension, the student must complete the Extension to Achieve Candidacy form and present it to the IBBME Graduate office with the causes for the delay and evidence that the remaining candidacy requirements will be completed within the period of the extension requested. The completed Extension to Achieve Candidacy form and all supporting documents for the extension must be filed at the graduate unit. A copy of the completed Extension to Achieve Candidacy form must be submitted to SGS for processing before the deadline to achieve candidacy.

3.5 Collaborative Program in Biomedical Engineering – MASc
The Collaborative Program involves close collaboration with many other departments within the University. Students in the Collaborative Program leading to a Master of Applied Science
Course requirements for the Collaborative Program are determined by the home and collaborating departments, but must include:

- Four half-credit courses, one of which must be BME 1450H Bioengineering Science.
- Students with engineering or physical science background must take a life science course.
- Students with a life sciences background must take an engineering or physical science course.*
- BME 1010Y Graduate Student Seminar Series.
- Health & Safety Training Workshop, WHMIS, and Biohazard & Safety Workshop.
- Faculty of Engineering ‘Ethics in Research’ Seminar (JDE1000)
- Completion of a research thesis.

* For examples of courses, please see Appendix G and H.

A student in the collaborative program is responsible for informing IBBME if they bypass to a PhD program in their home department and confirming if they would like to remain in the collaborative program.

**3.6 Collaborative Program in Biomedical Engineering – PhD**

The advanced level of research in the PhD program requires candidates to have completed a master’s degree. Candidates register in the School of Graduate Studies through their collaborating departments. The program of study for students admitted into the PhD program will include a thesis in the field of biomedical engineering. Students will be required to take a minimum of two half-credit courses which must include BME 1450H Bioengineering Science if it has not already been taken. Engineering or physical science students must take a life science course as described above, while life science students must fulfill a physical science course as described above (See Appendix G and H). Applicants must have an A- average in their last two years of studies. All required courses should be completed within the first year, and no more than four years should be needed to complete all degree requirements.

Regulations governing student progress are defined by the collaborating departments. Collaborating departments are listed in Appendix E. Students are also required to attend a minimum of eight of the Graduate Student Seminar Series (BME 1010Y/1011Y) from September to May of each year. Selected course descriptions can be found in Appendix F.
4.0 SEMINAR REQUIREMENTS

IBBME core, and collaborative students are required to attend a minimum of six Graduate Student seminars two Distinguished Seminar Series talks (BME1010Y and BME1011Y) each academic year. MASc and MHSc students are required to present their research in year two of their program and PhD students are required to present in year four or five of their program. Attendance in the seminar series is a requirement of your program. Any student failing to attend less than eight seminars per academic year will be considered as non-participating and will receive an Incomplete on their transcript, which will prevent them from graduating.

The primary goal of the IBBME Student Seminar Series is to provide practical experience and guidance in the clear, concise oral communication of research results to an audience of educated, though not specialist peers. This is an essential skill for anyone intending to seek a career in scientific research. The emphasis is different than that of a group meeting or conference style talk to a specialist audience; the emphasis here is on the skills that are important for job talks or teaching situations.

Another important goal of the series is to provide a broad knowledge of all aspects of research undertaken by other students in IBBME. Attendance at the Student Seminars is a great way to see the broad scope and reach of the graduate program at IBBME and can often offer new insight into your own research. A good, interactive audience is essential to the success of this series – so ask questions.

Please be sure to notify your supervisor and supervisory committee members as soon as you are provided with a presentation date so that they can allocate time in their schedules to attend.

Abstract Submission:
Concise abstracts (~ 250 words), including the names of your supervisor and supervisory committee members must be provided prior to your seminar. These will be distributed electronically to all members of the IBBME community and posted to the IBBME web page. All speakers should email their abstracts to the Graduate Administrator or Teaching Assistant by 5:00 pm the Monday of the week before your seminar. Abstracts should not be over one page in length.

Note:
The Graduate Office will not normally grant any exemption or allow a student to postpone her/his seminar requirement in order to protect intellectual property. Alternatives can be discussed with the Graduate Coordinator.

5.0 COMMITTEE MEETINGS

All graduate students with the Institute of Biomaterials and Biomedical Engineering are required to have at least one committee meeting within twelve months of registration. Annual committee meetings are required while the student remains registered. For PhD students, a supervisory committee meeting is recommended to be held before the PhD Qualifying examination (e.g. a student who has started her/his program in September 2018, could have a first supervisory committee meeting in March 2019 and then the PhD Qualifying Exam in May 2019). Afterwards, the committee meetings can be held annually or more frequently during specific periods if the student, the supervisor and/or the committee feels it could be beneficial to the research progress.
At each meeting, the supervisory committee will assess the student's progress in the program and provide advice on future work. If after two consecutive meetings a student's supervisory committee reports that the student's progress is unsatisfactory, the Graduate Office may recommend to the School of Graduate Studies the termination of registration and eligibility of that student. A student who encounters difficulties arranging a meeting of this committee should consult the Graduate Coordinator or the Director in advance of the relevant deadline for doing so. A student who, through his or her own neglect, fails to meet with the supervisory committee in a given year will be considered to have received an unsatisfactory progress report from the committee.

The SGS policy on this can be found at the following page:

http://www.sgs.utoronto.ca/currentstudents/Pages/Maintaining-Good-Standing.aspx

Students in the Collaborative program are also required to have one committee meeting every twelve months. If your home department has a similar requirement, then please give a copy of your committee meeting report to the IBBME Graduate Office in order to fulfill the IBBME committee meeting requirement.

Your supervisory committee is comprised of a group of professors who will assist you and your supervisor in progressing through your graduate program. The members of this committee are responsible for monitoring your progress on a regular basis and must meet at least once every twelve months unless the committee or student elects to meet sooner. All members of your supervisory committee must have an SGS appointment.

Committee members are selected and invited by you and your supervisor. You are advised to confirm the SGS appointments of potential committee members. Please also refer to Section 7 of the SGS calendar for a list of professors who have full SGS appointments. Faculty with associate SGS memberships may also sit on the Supervisory Committee. However, these individuals are not listed in the SGS calendar. Committee members may be selected from departments outside of IBBME, though your supervisor must have an IBBME appointment.

Your committee shall consist of a minimum of three voting members, including your supervisor. In situations where students have more than one supervisor, two additional committee members are required for a quorum of four voting members. A simple equation to determine the minimum number of committee members required is:

Supervisor (and co-supervisor) + two committee member (with SGS appointments)

Co-supervision by more than two supervisors will not be permitted. All voting committee members must be members of the School of Graduate Studies. Students are welcome to include non-voting members in the Progress Committee but must be aware of the requirement for voting membership for the final thesis defense. Students are cautioned that large committees can become problematic for scheduling of meetings and examinations.
Satisfactory performance rating by the committee is a requirement for continued enrollment and funding in your graduate program. Committee meetings are a requirement of your graduate program and an account of the committee meeting, and its deliberations, form part of the student’s official record and are reported on ROSI.

5.1 Committee Meeting Presentation and Progress Report

The committee meeting will consist of the following:

1. A progress report of not more than twenty pages including figures;
2. A 20 minute oral presentation on the progress to date and future work; and
3. A discussion of the thesis project.

Preparation for your Supervisory Committee Meetings

You are required to submit your research progress report to the members of the committee a minimum of ten business days in advance of the first committee meeting. At the same time, you are also required to notify the Graduate Office when your committee meeting will be held. The Graduate office will prepare a package containing documents (evaluation form + transcripts) for the Chair of your committee, which you must pick up from the Office and bring to your meeting. The initial progress report should include background information regarding previous research carried out in the field, what progress has been made to date with the student’s research project, any results achieved, and future work to be done. Charts and figures should be included in the report. For subsequent committee meetings, you will need to ensure that your progress report addresses the concerns raised by the committee during the previous meeting (or during your PhD Qualifying Exam, if applicable).

At the meeting, you will give a 20-minute presentation where you introduce your research topic, the goals of your project, the research hypothesis (if applicable), and the research methodology/approach. You should also provide a timeline for the completion of your project. You should expect to receive critical feedback from the committee about your proposed project plan.

The critical components of a proposal are:

1. Literature review – comprehensive, critical appraisal of the relevant literature. The literature review should provide rationale for your research. For example, the literature review may identify a shortfall of previous work, a gap in the literature or an opportunity for improvement or innovation.
2. Objectives/hypotheses – these are succinct statements of your research objectives (what you plan to achieve) and hypotheses (relating to the specific questions you want to answer), in light of your literature review.
3. Methods – this section should include everything you propose to do in sufficient detail for the committee to judge its viability. This section will include different items for each proposal, depending on the nature of your thesis. Below are some suggestions (which are not intended to apply to every thesis).

a. For theses involving experimental work, one would usually talk about the study design, the inclusion/exclusion criteria for research participants (if humans are involved), the instrumentation to be used, the experimental protocol/data collection and the anticipated data analysis.
b. For theses that are about device design, one might include technical specifications/requirements, the design methodologies, the proposed design (preliminary ideas), and the criteria, analytical methods or tests for evaluating the design.

c. For theses that focus on modeling a phenomena, you might include the assumptions of your model, the modeling methodologies, relevant computational tools, the proposed model (preliminary ideas), and the criteria, analytical methods or simulations for evaluating the model.

Of course, some of these items are subject to change as your project evolves. However, it is important to at least put down the tentative plan on paper. Your methods should be justified, for example, by the scientific literature or preliminary data.

4. Timeline – this usually takes the form of a Gantt chart or a table. It should map out all the major milestones from the first committee meeting to the completion of your thesis. You should probably include internships so the committee may gain a sense of how much time you’ll be able to devote to the project at different periods of the year.

5. Bibliography – literature references cited in the body of your proposal.

Note:
Your supervisor should read over your proposal before it is submitted to the committee. In fact, you should work closely with your supervisor in developing the proposal.

For every committee meeting, students must notify the Graduate Office two weeks in advance, providing the following information:
1. Title of research;
2. Date of meeting;
3. Name of supervisor, and co-supervisor if applicable;
4. Names of all other committee members.

5.2 Bypass examination
The bypass examination is for students in the MASc and MHSc programs who wish to transfer into the PhD, therefore it constitutes a PhD Qualifying Examination. Bypass exams must be completed within 14 months from the start date of the student's MASc or MHSc program. A first Supervisory Committee meeting must be held 3-4 months before the bypass examination (during the first year).

The bypass examination will consist of the following:
1. A progress report detailing progress to date which also includes a PhD research proposal. This report is to be thirty pages or less; and
2. A 20 minute presentation summarizing the work to date and the proposed research.
Preparation for your Bypass Examination:
You are required to submit a research proposal/report to the members of the committee a minimum of **ten business days in advance** of the examination. At the same time, you must also notify the Graduate Office when your examination will be held. The Graduate office will prepare a package containing documents (evaluation form + transcripts) for the Chair of your committee which you must pick up from the Office and bring to your meeting.

Assessment of the candidate will be based on the oral presentation, the written proposal, and the candidate’s performance during questioning by the committee (See Section 5.3). The candidate will be expected to answer questions relative to the research proposal, background required to undertake the work and potential applications. The emphasis of the examination will be on the research proposal, not on undergraduate level background. Students are expected to have completed all the appropriate course requirements by the date of the bypass examination.

Bypass Examination Committee
Bypass Examination Committees are made up of the PhD Supervisory Committee plus one independent examiner. Each committee must have:

1. A supervisor, and co-supervisor if applicable;
2. Two regular supervisory committee members who hold an SGS appointment;
3. An independent examiner (with an SGS appointment) not associated with supervision of the project but knowledgeable in the field

All voting committee members must hold an appointment with the School of Graduate Studies.

5.3 PhD Qualifying Examination
Students in the PhD program must successfully complete a Qualifying Exam within the first 14 months of their registration in order to continue in their program. A student should have a first supervisory committee meeting 3 to 4 months before her/his PhD Qualifying Exam (i.e. during the first year of the program). MASc students, who by pass into the PhD program, must have a bypass exam within 14 months of the date of their transfer into PhD and in this case the bypass exam serves as a PhD Qualifying Exam.

This exam will consist of the following:

1. A PhD research proposal of not more than thirty pages; and
2. Defense of the research proposal including a 20-minute oral presentation on the proposed research and defense.

Preparation for your PhD Qualifying Examination:
You must submit a research proposal/report to the members of the committee a minimum of **ten business days in advance** of the examination. At the same time, you must also notify the Graduate Office) of when your examination will be held. The Graduate office will prepare a package containing documents (evaluation form + transcripts) for the Chair of your committee which you must pick up from the Office and bring to your meeting.
The PhD qualifying exam committee should evaluate the student's background preparation and ability to undertake an original and conclusive scientific investigation that has the potential to develop into a full PhD thesis (ideally, three first author papers).

Specifically, the committee will:

1) evaluate student's ability to articulate a clear hypothesis or a clear overall goal (e.g. create a novel design, solve a specific problem, develop a new technology, challenge a current paradigm or practice, address a critical bottleneck in the field);

2) evaluate student's ability to plan and design critical experiments to prove or disprove the hypothesis or to achieve the overall goal stated;

3) evaluate student's ability to interpret experimental data/outcomes and appreciate the limitations of the approaches used;

4) evaluate student's familiarity with relevant literature and/or understanding of scientific concepts relevant to the project;

5) take into account the student performance in graduate courses.

The presentation of some preliminary data that supports the hypothesis or suggests feasibility is usually expected, but is not the main criterion for assessing students. Candidate assessment will be based on the oral presentation, the written proposal, and the candidate’s performance during questioning by the committee. The evaluation form is available through the Graduate Office. A vote will be held to recommend or not recommend that the candidate continue in the PhD program.

Students who do not successfully complete their Qualifying Exam may be given an opportunity for a second Qualifying Examination within six months. The Graduate Office will recommend termination of the registration of students who have failed their second attempt at the PhD qualifying examination (see Section 8.8). Decisions of the examination committee are final; however, they can be appealed (see Section 8.19). Candidates who have failed their PhD Qualifying Exam twice will not be considered for a transfer to the MASc program, as they are no longer in good standing (See section 8.6).

When the supervisory committee concludes that the student should not continue his/her program because of a lack of progress and/or poor academic performance, the student will have to withdraw from the program. If the student does not withdraw from the program, the graduate office will recommend that SGS terminate the student’s enrolment in the program. The latter has more serious consequences than a withdrawal since the termination status will be recorded permanently on the student record. In general, the same consequences can apply when a student is not in good academic standing.
Qualifying Examination Committee
PhD Qualifying Examination Committees are made up of the PhD Progress Committee plus one independent examiner. Each committee must have:

1) Supervisor and co-supervisor if applicable;
2) Two regular supervisory committee members who hold an SGS appointment;
3) Independent examiner (with an SGS appointment) not associated with supervision of the project but knowledgeable in the field

All voting committee members must hold an appointment with the School of Graduate Studies.

5.4 Collaborative Program Committee Meeting Requirements
All students who are in the Collaborative Program with the Institute of Biomedical Engineering Program are required to have at least one committee meeting within twelve months of registration and annually every year thereafter. In general, your home department’s committee meeting schedule will satisfy this requirement. However, in the event that the student’s home department does not require an annual Progress Committee meeting during the course of their program, students will be required to hold annual meeting, as scheduled for our core students, to satisfy the IBBME requirement.

6.0 ENROLMENT AND COURSE WORK
After the initial payment of fees, students normally select appropriate courses by completing an enrolment form. This is usually done in consultation with the student’s supervisor and approved by both the supervisor and the graduate coordinator. Students registered in the BME Program must submit the forms to the IBBME Graduate Office for processing while students in the Collaborative Program submit them to the collaborating departments and follow the guidelines of the collaborating departments with copies provided to the IBBME Graduate Office.

6.1 Adding and Dropping Courses
Students who wish to add or drop courses after enrolment must complete an Add/Drop Form. The form must be submitted to the department after obtaining all necessary approvals. A student will not be able to add or drop courses after the prescribed deadlines of the department. The Institute’s prescribed deadlines for changes are one week prior to the deadline dates scheduled at the School of Graduate Studies. For more information, see the SGS website at www.sgs.utoronto.ca.

6.2 Grading and Evaluation
Students normally receive a grade report for all courses completed within a given term. These reports are not official transcripts. Students requesting official transcripts must order them from the University of Toronto Transcript Centre located in the Sidney Smith Building at 100 St. George Street. Students may also obtain grades from the Student Web Service at http://www.rosi.utoronto.ca.

Additional information relating to grading scales and grading policies are found in the SGS Calendar under the section titled Graduate Grading and Evaluation Practices Policy.
6.3 Extra Courses Not Required for the Degree

Enrolments for additional courses not required for the degree are subject to the same regulations as those in the degree program. Students should check with the host department about course enrolment procedures.

6.4 Academic Standing and Satisfactory Progress

All graduate programs are composed of a number of academic requirements that include graduate courses and other academic activities, including participation in student seminars, annual committee meetings and student research. Students are required to maintain a minimum grade performance of A- in all graduate courses to be eligible for most scholarships. Students must maintain satisfactory progress in their research in order to remain in Good Standing with SGS and IBBME during completion of their degree program.

Progress in your degree program will be assessed each year and is measured by:

- Performance in your courses (the passing mark is B- in all courses, i.e. 70% and most graduate scholarships require a minimum GPA of A- or 3.7 for eligibility)
- Supervisory Committee Meetings (yearly or more frequently)
- Satisfactory progress in research

After each session, the Departmental Graduate Studies Committee will consider the cases of those students who have failed one graduate course. Students with one failure who are allowed to proceed will have their cases reviewed by the Graduate Office. Students who find themselves in this situation are strongly encouraged to contact Accessibility Services (www.accessibility.utoronto.ca) to determine if accommodations can be put in place to meet specific needs they may have. The Graduate Office’s policy is to recommend to SGS the termination of the registration of students who at any time accumulate two failing grades. Consequently, failing courses can have very severe consequences and difficulties should be addressed as soon as possible.

Students whose research work is unsatisfactory in the opinion of their supervisory committee, and/or have not completed their degree requirements after six sessions (24 months) and/or have not held an annual committee meeting, may also face termination of their registration in their graduate program. The committee has complete authority to recommend the termination of a student’s degree program if adequate progress is not demonstrated.

Failure to remain in good standing can affect student’s eligibility for internal and external funding, registration and continuation in your program.

Please review SGS policy on Program Progress and Good Standing:

http://www.sgs.utoronto.ca/calendar/Pages/Good-Academic-Standing-Satisfactory-Academic-Progress-Time-Limits-Supervision-Candidacy.aspx
7.0 THESIS REQUIREMENTS

7.1 Biomedical Engineering Program: MASc
Completion of the MASc in Biomedical Engineering requires the submission of a thesis on an original body of work in the field of biomedical engineering and an oral defense of that research. It is highly recommended to have a Supervisory Committee meeting a few months before completing the thesis and before scheduling the oral defense. A final oral examination will not be scheduled if the student has never had a committee meeting during his program. Examination of the candidate will be based on both the oral presentation and the written thesis.

In order for the thesis to be properly appraised, students are requested to submit the thesis to the examination committee not later than two weeks before the exam. Failure to do so may result in cancellation of the examination. Students must also notify the IBBME Graduate Office of their scheduled exam not later than two weeks before the exam date so the exam documents can be prepared. The examination meeting arrangements (room booking, contacts members, etc) are the responsibilities of the student.

Departmental Defense – Examination Committee
The examination committees are made up of the MASc Progress Committee plus one independent examiner. Each committee must have:

1) A supervisor and co-supervisor if applicable;
2) Two regular supervisory committee members who hold an SGS appointment;
3) An independent examiner (with an SGS appointment) not associated with supervision of the project but knowledgeable in the field.

All voting committee members must hold an appointment with the School of Graduate Studies.

On the basis of the thesis and the Departmental defense, the committee may recommend that:

- The thesis may be accepted as is and the candidate be awarded the MASc degree;
- The candidate be awarded the degree subject to minor corrections of the thesis;
- The candidate be awarded the degree subject to minor modifications of the thesis;
- The candidate be given an opportunity to address shortcomings in his/her thesis or defense with the objective of a reconvened oral examination to be held at a later date;
- The candidate withdraw from the program.

Thesis Corrections
Those committee members who find the thesis acceptable must also indicate whether the thesis is acceptable as is, or requires minor corrections or minor modifications.

- Minor corrections involve typographical errors, errors in punctuation, or problems in style; they must be correctable within one month.
• Minor modifications are more than changes in style and less than major changes in the thesis. A typical example of a minor modification is clarification of textual material or the qualification of research findings or conclusions. Minor modifications must be feasibly completed within three months.

For the procedure to be followed in case of a split vote, see the explanation on the voting ballot.

**Submitting your Thesis**
Theses will be electronically archived by both the UofT Library and LAC in their secure digital repositories. Theses are also submitted, by SGS, to ProQuest for publication with Abstracts International.

[http://www.sgs.utoronto.ca/currentstudents/Pages/Electronic-Thesis-Submission.aspx](http://www.sgs.utoronto.ca/currentstudents/Pages/Electronic-Thesis-Submission.aspx)

### 7.2 Biomedical Engineering Program – PhD
Completion of the PhD in Biomedical Engineering requires the submission of a thesis on an original body of work in the field of biomedical engineering and an oral defense of the research. The thesis is to be formatted as described by the School of Graduate Studies.

**Departmental Examination**
The PhD candidate will undertake up to two examinations in completing the thesis requirement for the PhD in the Biomedical Engineering Program - a Departmental Oral examination and the Senate Examination (Final Oral Exam). In both cases the candidate will be examined on both the oral presentation and the written thesis.

The Departmental Oral Defense is a public event. Peers and faculty are invited to attend but will be asked to leave the exam room during deliberation. The candidate will be examined based on a 20 minute presentation of their work and will be expected to answer questions relative to the research thesis, background and future work.

**Departmental Defense – Examination Committee**
The examination committees are made up of the PhD Progress Committee plus one independent examiner. Each committee must have:

1) A supervisor, and co-supervisor if applicable;
2) Two regular supervisory committee members;
3) An independent examiner (with an SGS appointment) not associated with supervision of the project but knowledgeable in the field.

All voting committee members must hold an appointment with the School of Graduate Studies.

On the basis of the thesis and the Departmental oral defense, the committee may recommend that:

- The candidate be allowed to proceed to the Senate Examination;
The candidate be given an opportunity to address shortcomings in his/her thesis or defense with the objective of a reconvened Departmental oral defense being held at a later date; or

- The candidate withdraw from the program.

The Departmental Oral Defense is optional but highly recommended. Students may opt to go straight to the Final Oral Exam with the recommendation of the supervisory committee and authorization from the Director or Associate Director of IBBME. Students must provide a written request to the Graduate Programs Administrator requesting to proceed straight to the Final Oral Exam.

**Final Oral Examination**

The Final Oral Examination is described on the SGS website. Students should anticipate that organizing a Final Oral Exam (FOE) will take at least eight weeks to coordinate and should schedule accordingly. Please see Appendix B for an overview of the FOE timeline.


The FOE committee must include at least four, but no more than six, voting members: one to three of the voting members will have served on the candidate's supervisory committee, and at least two voting members will not have been closely involved in the supervision of the thesis. Eligible for inclusion in the latter group are the external appraiser (in person or by audio connection), the internal-external committee member from the departmental defense, or members of the graduate faculty of the candidate's graduate unit, and members of the graduate faculty of other departments, centres, or institutes of the University.

1) A supervisor, and co-supervisor if applicable;
2) One – two regular supervisory committee members;
3) An independent examiner (with an SGS appointment) not associated with supervision of the project but knowledgeable in the field. This can be the internal-external from the departmental defense.
4) The external appraiser or a second independent examiner should the external appraiser not be able to participate.
5) SGS will appoint a non-voting chair to the examination committee.

**Embargo on PhD thesis publication:**

Publication of the thesis by the University of Toronto is a requirement of the PhD degree. Delaying its publication is viewed as an exceptional case. The Graduate Office will limit the embargo to a maximum of one year.

The justification for the embargo should be approved by the IBBME Director and SGS and this process requires using a restrict thesis release form.
8.0 GENERAL INFORMATION

8.1 Supervision: What you should expect
The University has recently undertaken an initiative to assist students in receiving strong supervision during their graduate degree. You should be sure that you are familiar with the SGS guidelines for Graduate Supervision. (http://www.sgs.utoronto.ca/Documents/Supervision+Guidelines.pdf).

8.2 Safety
It is mandatory for all registered students to attend the Health & Safety Training course at the beginning of the program, and take the WHMIS refresher course annually thereafter. You will be prohibited from starting your research until this requirement is completed. This is in addition to any safety sessions you may be required to undertake at your lab’s physical location. You should be aware of your responsibility under the Safety Act, which governs safety in the workplace in Ontario. You should also be aware of the Biohazard, Laser, and Radiation protocols particular to your research and research environment.

8.3 Ethics
All of the research undertaken in IBBME is covered under several ethical review programs. You must be aware of guidelines on Research Involving Human Subjects and attend ethics courses as required.

http://www.sgs.utoronto.ca/facultyandstaff/Pages/Research-Involving-Human-Subjects.aspx

8.4 Intellectual Property and the Graduate Student
Students must be aware of the issues around Intellectual Property and their research. Please refer to the Faculty of Medicine (www.facmed.utoronto.ca) and the SGS websites (www.sgs.utoronto.ca) for updates and guidelines.

8.5 Plagiarism and other Cases of Academic Misconduct
Students in graduate studies are expected to commit to the highest standards of integrity and to understand the importance of protecting and acknowledging intellectual property.

The University’s policy on academic misconduct is found in the Code of Behaviour on Academic Matters can be found on the SGS website under Information for Students. It is the student’s responsibility to be aware of these policies. In particular, make sure you know exactly what is considered plagiarisms in the context of your progress reports, proposal, manuscripts and thesis and how to avoid it (http://advice.writing.utoronto.ca/using-sources/how-not-to-plagiarize/).

http://www.sgs.utoronto.ca/facultyandstaff/Pages/Academic-Integrity.aspx
8.6 Transfer to Other Programs (including transfer from PhD to MASc)

**Transfer from PhD to MASc**

This option is available to students who have not already completed an MASc in Biomedical Engineering at the University of Toronto, who are in *Good Standing* in their PhD program but who feel that the length and expectations of the PhD program are no longer compatible with their career plans. Students transferring from the PhD to the master's program must complete all of the normal MASc degree requirements (including courses), or their equivalent, in order to be awarded the master's degree. These transfers must be approved by the Graduate Office and the SGS Vice-Dean, Students. Students who transfer from the PhD to the master's program will not be permitted to transfer subsequently to the PhD program within the same graduate unit unless approved by the SGS Admissions and Programs Committee.

http://www.sgs.utoronto.ca/calendar/Pages/Degree-Regulations.aspx

Note that PhD candidates who have twice failed their PhD Qualifying Exam will not be considered for a transfer to the MASc program since they are no longer in good standing.

**Transfer to/from another Department:**

Students who wish to transfer from another department after registration must obtain necessary approvals from his or her supervisor(s) as well as the Graduate Coordinators from the departments. Transfers will normally not be permitted after one year of registration in a program. If a new research supervisor is being selected, the supervisor must be a full member of the School of Graduate Studies. A letter of acceptance is also required from the supervisor accepting the student into his/her research lab and financial responsibility.

8.7 Change of Primary supervisor

In exceptional circumstances, a student may wish to change his/her primary supervisor. In such a case, the student should discuss this plan with the Graduate Coordinator so that all pros and cons and all other possible other alternatives have been considered. Normally, the Graduate Office will give the student a defined, but limited, period of time to identify a new supervisor (who may be from within or outside of IBBME). In addition, a student can decide to take a one semester standard leave of absence during that period, if eligible. Note that it is ultimately the responsibility of the student to identify and establish a relationship with their intended research supervisor; the student may request some assistance from the Graduate Office during this process but the Graduate Office cannot simply transfer a student from one supervisor to another. Therefore, a change of supervision should be attempted only when there are no other alternatives since there is no guarantee that it will be possible.

If the student unilaterally decides to stop working with his/her current supervisor and a new supervisor cannot be identified during the time period prescribed by the Graduate Coordinator, then the Graduate Office may recommend that the student consider withdrawing from his/her
graduate program in IBBME (see Section 8.8) as graduate students must have a supervisor in order to meet the requirements of their program.


8.8. Program Withdrawal and Termination of Registration
The Graduate Office may request to SGS the termination of the registration of students who have failed two or more graduate courses, or have failed two attempts at their PhD Qualifying Examination or have showed a lack of research progress in two subsequent committee meetings. Normally, the Graduate Office will give student the chance to voluntarily withdraw from the program within a defined time period before the request for termination is formalized with SGS (a termination status can have serious consequences as it is permanently recorded on student transcripts). However, it is important to note that termination can be appealed to the Graduate Academic Appeals Board of SGS but that withdrawal cannot. Students in this situation are encouraged to obtain additional information about appeals and withdrawals from SGS in order to make their decision.

http://www.sgs.utoronto.ca/facultyandstaff/Pages/Termination-Student-Info.aspx

8.9 Change of Address
Students are responsible for updating any address and/or telephone changes via the Student Web Services at http://www.rosi.utoronto.ca. In addition, students should also inform the Graduate Office and the Administrative Office in writing. We will make the necessary changes in the payroll system.

8.10 Office Space and Keys
Office or desk space is usually assigned to students upon registration. Inquiries related to office space allocation should be directed to the Operations Assistant. IBBME students who require keys for their offices or laboratories should contact the IBBME Administrative Office, Room 407 of the Rosebrugh Building.

8.11 Mailboxes
There is one mailbox located in Room 407 of the Rosebrugh Building for any personal mail that may arrive for students.

8.12 Student Cards and E-mail Address
The U of T TCard is an access card for services on campus. Email service, wireless network, and access to the Learning Portal will be available upon receipt of your TCard and authentication of your UTORid. You may obtain your TCard at any one of the three campus locations. Check out TCard News for dates when you are eligible to pick up your TCard.
Proof of citizenship, identification and your offer of admission letter or student number are required in order to receive a TCard. For detailed information about the documentation required to obtain a TCard, visit http://tcard.utoronto.ca

Before arrival on campus, you can use your JOINid to access your student account on ACORN to update contact information. Upon receipt of your TCard, you will be given a Secret Activation Key to promote your JOINid to a fully valid UTORid.

Your email account at U of T is associated with your UTORid. It is important to activate your UTORid to receive communications from U of T, SGS, and the Graduate Awards Office.

See also: UTmail+, an email and calendaring service for students and alumni.

Your University of Toronto email address is the official contact point for all University-related announcements and notices posted by the School of Graduate Studies and your Graduate Unit. Please note that, for security purposes, Faculty and Graduate Offices are prohibited from opening emails that do not come from a University of Toronto account. You are responsible for ensuring that this account is checked regularly.

8.13 Purchases
Students making a purchase should consult with their supervisors ensuring that proper approvals are granted prior to purchasing.

8.14 Fax and Photocopy
Fax and photocopying machines are located in the IBBME Graduate Student Office, Room 410 of the Rosebrugh Building. Students using the photocopying machine must enter login identification assigned by the Administrative Office.

8.15 Payroll
Students registered in the Biomedical Engineering Program or the Clinical Engineering Program should direct all payroll inquiries to the IBBME Administrative Office; Collaborative students should contact their home department’s business officer for information.

8.16 Leaves of Absence and Student Personal Time Off
Guidelines on Leaves of Absence (http://www.sgs.utoronto.ca/calendar/Pages/Registration-and-Enrolment.aspx)

Graduate students whose programs require continuous registration may apply to their Graduate Coordinator for a one-session to three-session leave during their program of study for:

1. serious health or personal problems which temporarily make it impossible to continue in the program; or
2. **parental leave** by either parent at the time of pregnancy, birth or adoption, and/or to provide full-time care during the child’s first year. Parental leave must be completed within 12 months of the date of birth or custody. Where both parents are graduate students taking leave, the combined total number of sessions may not exceed four.

Once on leave, students will not be registered, nor will they be required to pay fees for this period. In general, students on leave may not make demands upon the resources of the university, attend courses, or expect advice from their supervisor. As an exception, students on leave for parental or serious health reasons who wish to consult with their supervisor or other faculty are advised to make special arrangements through their department. Students on leave will not be eligible to receive University of Toronto financial assistance. In the case of other graduate student awards, the regulations of the particular granting agency apply.

Students may make application for a leave by completing the leave of absence form ([http://www.sgs.utoronto.ca/Documents/Leave+of+Absence.pdf](http://www.sgs.utoronto.ca/Documents/Leave+of+Absence.pdf)) and submitting it to the IBBME Graduate Office for approval. The form is then sent to the School of Graduate Studies for processing. The termination date of the degree program will be extended by the duration of the leave taken, i.e., one, two, or three sessions as appropriate. Except for parental leave or in exceptional circumstances, it is not expected that a student will be granted more than one leave under the terms of this policy. Normally the start and finish of the leave would coincide with the start and end of a session.

**Guidelines on Personal Time Off**

It is recognized that many graduate students conduct their research almost exclusively within a laboratory setting, where they may or may not have control over their hours and the flow of the research program. Students are not employees and therefore have no rights to employee benefits, including paid vacation entitlement. However, it is recognized that in order for a graduate student to reach their full potential and achieve academic excellence and maintain a healthy work/life balance, they benefit from some personal time off or vacation. There are SGS policies and procedures in place for students who require a leave of absence for parental, personal or medical reasons. However, there are no University or SGS policies regarding graduate student personal time off or vacation. The following guidelines for faculty and graduate students provide a framework for reasonable expectations. As a general rule, students might reasonably expect up to three weeks (fifteen working days) per year in personal time off, plus statutory holidays, under the following conditions:

- Time off provisions should be negotiated, in a clear and transparent manner, between the supervisor and the graduate student.
- Time off should not compromise the research program and/or the student’s graduate studies. Students must ensure that laboratory work, experimentation and other time-sensitive activities are either completed, or arrangements made for others to continue ongoing work.
- Consideration should be given to when the building or lab is closed (i.e. winter holidays) when taking time off.
- Time sensitive deadlines (i.e. award applications, abstract submissions) must be taken into consideration.
• Time off cannot be carried forward from year to year.
• Time off should be requested as far in advance as possible.
• The student and supervisor should be able to maintain contact as appropriate if the student is away for an extended period.
• Given that students receive remuneration as a stipend, not salary, the stipend continues, unaffected by personal time off.
• Attendance at social activities within the academic community (departmental picnic, etc.) or scientific meetings do not fall under the category of personal time off.
• Sick leaves or absences for health reasons must be documented and do not fall under category of personal time off.

8.17 Graduate Course Grade Scales
The Table below presents the grade scale for graduate courses. IBBME requires the completion of every course taken for graduate credit with a least a mark of B- (or 70%). However, eligibility for most graduate scholarships requires a GPA of at least A-. A grade below 70% is inadequate and indicated on the transcript by FZ (fail) and cannot be counted for credit. A student who has received an FZ in a course should speak with the Graduate Coordinator to get the permission to either repeat the course or substitute another one. This permission may be given to the student if his/her marks in other course(s) taken is/are above the minimum required. Normally, a student will not receive this permission more than once. If a student fails two courses, the Graduate Office will recommend to SGS termination of student’s registration in the program (see Section 6.4).
8.18 Policy on Extension and Late Withdrawal Requests for Graduate Courses

A request for an Extension in a graduate course should be sent to the Instructor within two business days after deadline for completing that particular component of the course. The request must be supported by medical documentation (see http://www.illnessverification.utoronto.ca), if the reason for the request is due to an illness.

If the extension required for the completion of the coursework is beyond the original SGS deadline to submit the marks for that course (e.g. past the end of the session) then the request will have to be sent to the Graduate Office. Students will petition the graduate unit for extensions, using a standard form provided by SGS (http://www.sgs.utoronto.ca/Documents/Extension+to+Complete+Coursework.pdf).

We strongly recommend that students request an extension instead of a late withdrawal for course whenever applicable. A request for a late withdrawal for a course should be sent to the Graduate Office as soon as possible during the session in which the course is offered. Such requests are approved only for exceptional circumstances such as a very serious illness or bereavement. These requests must be supported by appropriate medical documentation (http://www.illnessverification.utoronto.ca), if the

![Truncated Refined Letter Grade Scale](http://www.governingcouncil.utoronto.ca/Assets/Governing+Council+Digital+Assets/Policies/PDF/grading.pdf)
reason for the late withdrawal is due to a medical condition. The Graduate Office is not likely to approve a request for a late withdrawal after the final course marks have been communicated to the students.

http://www.sgs.utoronto.ca/calendar/Pages/Registration-and-Enrolment.aspx

Requests for Extensions or Late Withdrawals may be granted or denied by the Graduate Office. In the case of an extension, if the course is never completed by the deadline prescribed by the Graduate Office, then the report of INC (incomplete) is permanently recorded on the student’s transcript.

8.19 Academic Appeals (for a course mark, course failure or other academic decisions)

Note that decisions made by Instructors, Supervisors, Supervisory Committees and the Graduate Office can be appealed. Academic appeals are initiated within IBBME (with the exception of appeals related to Termination of Registration and Final Oral Examination failure which are appealed directly at the SGS level). When possible, the Graduate Office or the Director will provide assistance to attempt to settle the appeals informally between the parties involved (e.g. student, instructor, supervisor, supervisory committee).

If a student wants to appeal a decision made by the Graduate Office, the first step in the process is to send a notice of appeal (http://www.sgs.utoronto.ca/Documents/GDAAC+Notice+of+Appeal.pdf) to the Professor chairing IBBME’s Graduate Department Academic Appeals Committee (GDAAC). The GDAAC will review the case and will make a recommendation to IBBME’s Director (or his/her substitute) who then makes a decision. The appeal can then subsequently be taken to the Graduate Academic Appeals Board (GAAB) of SGS, and then to the Academic Appeal Committee of the Governing Council of the University.

http://www.sgs.utoronto.ca/facultyandstaff/Pages/Graduate-Academic-Appeals.aspx
http://www.sgs.utoronto.ca/calendar/Pages/Academic-Appeals-Policy.aspx

8.20 BESA (BioEngineering Student Association)

BESA represents and promotes the student community at the Institute. They organize many of the social events for our students, and are quite busy listening to students expressing their views, ideas, or concerns related to any matters. Further information about BESA can be found at http://besa.ibbme.utoronto.ca/

8.21 The Essential Grad Guide

The Essential Grad Guide is a booklet for new students that contains information about registration and services offered by SGS and the University of Toronto. The electronic copy of the booklet is posted on the SGS website at http://www.sgs.utoronto.ca/Documents/Essential+Grad+Guide+2014-15.pdf.
8.22 SGS forms
Most forms used by SGS/Graduate Office can be found here:

http://www.sgs.utoronto.ca/currentstudents/Pages/Student-Forms-and-Letters.aspx

8.23 Important Contact Information

RS = Rosebrugh Building
MB = Mining Building
CCBR = Terrence Donnelly Centre for Cellular and Biomolecular Research

Professor Warren Chan – Director, IBBME
Office: RS407, (416) 946-0020; mailto:warren.chan@utoronto.ca

Professor Jonathan Rocheleau – Associate Director, Research
416 581-7839; jon.rocheleau@utoronto.ca

Professor John Davies, Associate Director, Graduate Programs
Office: MB330, 416-978-1471; jed.davies@utoronto.ca

Professor Jan Andrysek, Associate Director, Professional Programs
Office: MB329, (416) 978-1311; jan.andrysek@utoronto.ca

Professor Dawn Kilkenny, Teaching Stream & Associate Director, Undergraduate Programs
Office: MB321, (416) 978-8335; dawn.kilkenny@utoronto.ca

Rhonda Marley, Graduate Programs Administrator
Room MB332, (416) 978-4841; rhonda.marley@utoronto.ca

Jenia Bloch, Professional Programs Administrator
Room MB332, (416) 978-6102; mhsc.ibbme@utoronto.ca, meng.ibbme@utoronto.ca

Carina Esmael, Interim Undergraduate Programs Coordinator
+1 416 978-7209 (office)
mailto:undergrad.ibbme@utoronto.ca

Barbara Alexander, Manager of Operations
+1 416 978-4801 (office)
mailto:manager.ibbme@utoronto.ca

- Budget Management
- Space Management
- Personnel/Human Resources
• Business development
• Occupational health & safety

Judy Gilligan, Operations Assistant
Room RS407, (416) 978-7459; operations.ibbme@utoronto.ca

• Receiving for packages/couriers
• Equipment inventory
• Institute signage
• Key distribution
• Telecommunications

Angela Rosa, Finance Officer - Research
Room RS407, (416) 946-7310; payments.ibbme@utoronto.ca

• Financial
• Grant account reconciliation

Elizabeth Flannery, Human Resources Assistant & Finance Officer
Room RS407, (416) 946-7310; hr.ibbme@utoronto.ca

• Personnel and human resources
• Payroll – Faculty/Student/Admin
• Teaching Assistantships
• Mastercard files

Jody Prentice, Administrative Assistant to the Director
Room RS407, (416) 946-8258; director.ibbme@utoronto.ca
APPENDIX A - COMMITTEE INFORMATION

What Happens at Committee Meetings
The general meeting agenda is as follows:

- You will be asked to leave the room for a few minutes. The committee will review your file and discuss any concerns.
- You will be invited back into the room and will be asked to give a 20-minute presentation of your proposed research.
- The committee will usually go through two rounds of questions/comments/suggestions. You respond to questions/suggestions as appropriate.
- You will be asked to leave the room. The committee fills out the standard IBBME Thesis Committee Meeting Evaluation Form, which includes an evaluation of your progress, strengths, weaknesses etc.
- You will be invited back into the room and the committee will depart. Your supervisor will relay the committee’s comments/suggestions to you.
- Once the committee evaluation form has been completed, you sign the document. It is your responsibility to make a copy for yourself and to give the original copy to the Graduate Office (for MSc or PhD) or CE Office (for MHS). The form will be added to your file and recorded on ROSI.

If the progress of a student is deemed “unsatisfactory” by the committee, the Graduate Coordinator will discuss the situation with the student and the student’s supervisor.

Scheduling Committee Meetings
You will need about a month to organize a committee meeting. It is your responsibility to arrange your meetings. The necessary steps are listed below.

- Find a day and time that is suitable for your supervisor and committee members.
- Book a seminar room. You may choose to use IBBME Library located in Room 407, Rosebrugh Building. This can be done either with the Graduate Office or the CE Office, whichever is appropriate. This must be done at least two weeks in advance. **You may request to book a room only if all the committee members have confirmed their availability to attend.**
- Contact the Graduate Office or Clinical Engineering Office, whichever is appropriate, at least ten days before your scheduled meeting to ensure all your paperwork will be ready for your meeting date.
- Finally, send a confirmatory email to your supervisor and committee members. It is often useful to send a reminder to your supervisor and committee members at least one week in advance.
<table>
<thead>
<tr>
<th>Meeting Type</th>
<th>Timeline</th>
<th>Committee Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Committee Meeting</td>
<td>Minimum of once every 12 months for Master’s and PhD, including Collaborative Program participants. 1st PhD supervisory committee meeting should be after 8 months from start, 3-4 months before PhD Qualifying Exam</td>
<td>3 Members: Supervisor + 2 SGS Appointed Members</td>
</tr>
<tr>
<td>Master’s Bypass Exam</td>
<td>Within the first 12 – 14 months of the Master’s program</td>
<td>4 Members: Supervisor + 2 Regular Members of the Supervisor Committee + 1 External Member</td>
</tr>
<tr>
<td>PhD Qualifying Exam</td>
<td>To be completed within 14 months of initial registration in the PhD program for direct admits</td>
<td>4 Members: Supervisor + 2 Regular Members of the Supervisor Committee + 1 External Member</td>
</tr>
<tr>
<td>Master’s Defense</td>
<td>The Master’s should be defended within 2 years of initial registration</td>
<td>4 Members: Supervisor + 2 Regular Members of the Supervisor Committee + 1 External Member</td>
</tr>
<tr>
<td>PhD Departmental Defense</td>
<td>Should be held within 3-4 years of the PhD program (direct admit) or 5 years for those who bypassed to the PhD from the master’s</td>
<td>4 Members: Supervisor + 2 Regular Members of the Supervisor Committee + 1 External Member</td>
</tr>
<tr>
<td>PhD Final Oral Exam</td>
<td>Following a PhD Departmental Defense</td>
<td>4-5 Members: Supervisor + 1 or 2 Regular Members of the Supervisor Committee + 1 Internal Member (the External Member from the Departmental Defense) + External Member (usually the External Appraiser)</td>
</tr>
</tbody>
</table>

Note: Should a student have a Supervisor and a Co-Supervisor, the minimum number of committee members will increase by one. Should any clarification be needed, please contact the IBBME Graduate Office.
APPENDIX B - PhD FINAL ORAL EXAM (FOE) TIMELINE

Eight Weeks in Advance of FOE:

- PhD candidate will inform the Graduate Office of intention to proceed to FOE and provide:
  - A proposed date of defense;
  - A list of four or five, FOE committee members (see table in Appendix A, page 40);
    - Only three regular committee members (including supervisor) can serve as voting members on your SGS defense.
    - FOE committee must contain two non-supervisory committee members. Non-supervisory members are typically the external appraiser and the internal-external committee member from your departmental defense. In cases where their external appraiser does not participate in the SGS defense - either in person, Skype or teleconference - then a second internal-external member must be found.
  - A ranked list of three possible External Appraisers including biographical information and curriculum vitae, to be approved by the Director of IBBME. The External Appraiser must meet the following criteria:
    - Be external to the University as well as to its affiliated teaching hospitals and their research institutes;
    - Be a recognized expert on the subject of the thesis, and an Associate or Full Professor at his/her home institution. An appraiser from outside the academic sector must possess the qualifications to be appointed to an academic position at this level; and
    - Be at arm’s length from both the candidate and the supervisor(s). Normally, this will exclude anyone who has served as PhD Supervisor / Supervisee of the Candidate or the Supervisor; or has, in the past six years, been a departmental colleague of the candidate or the supervisor, or has collaborated on a research project, scholarly work or publication, with either of them.

Seven Weeks in Advance of FOE:

- The Graduate Office will get final approval for the External Appraiser.
- The PhD candidate must:
  - provide a copy of the printed thesis to the Graduate Office to be sent to the External Appraiser;
  - provide a thesis abstract to the Graduate Office, which will be sent to SGS;
  - Supply copies of thesis to the rest of the committee; and
  - Send a copy of the abstract to the Graduate Office.
- The Graduate Office will request a Chair to be assigned to the committee by SGS and will request a room to be booked if required (Candidate must indicate whether one is needed). The Chair request must be made a minimum of one month in advance of the examination date.

Six Weeks in Advance of FOE:

- External Appraiser receives copy of thesis.
2 Weeks in Advance of FOE:
- The Graduate Office will receive a copy of the thesis appraisal from the external examiner and will disperse to committee and candidate.
- Candidate is permitted to discuss the appraisal with supervisor and/or committee members
- Candidate **is not** permitted to discuss appraisal with the external appraiser.
APPENDIX C - THESIS STRUCTURE

Each degree candidate must present a thesis and pass an oral examination relating to their research.

Thesis Structure
A thesis generally contains the following components. Chapter titles and content may vary depending on the nature of the thesis.

Title Page: The title should precisely describe what the thesis is about. The most important key words that you think describe your research should appear in the title.

Abstract: This is usually one page in length, presenting the research problem, the main results, conclusion and how your thesis advances the field.

Acknowledgements: You may acknowledge funding agencies, supervisors, committee members, lab mates and anyone else you feel who was instrumental to the completion of your thesis.

Table of contents: List of chapters and sections.

A list of figures: A list of figures should be provided with specific page numbers.

A list of tables: A list of tables should be provided with specific page numbers.

A list of abbreviations: A list of all abbreviations used in the thesis and their explanations should be provided.

A list of equations: A list of equations as necessary with specific page numbers.

A list of foundations and funding sources: A list of all foundations that have contributed to the achievement of the final thesis.

Introduction: Usually this chapter includes the following:

- The area of research;
- The practical and theoretical value of the topic;
- Your research problem and why this was worthwhile studying;
- The objective of the thesis: how far you had hoped to advance knowledge in the field;
- The research method in brief; and
- A roadmap of the thesis - A paragraph about each chapter. What is the main contribution of the chapter? How do they relate to each other?

Statement of the problem and hypothesis: An explicit description of the analyzed problem and hypothesis
Related literature: A survey of the literature (theories, concepts and previous work) on the areas that are most relevant to your research question. This chapter should critically appraise the previous research area that you wanted to develop further or challenge.

Research method or design: This chapter details the research method by which you investigated the problem under study. This is essentially an updated version of the Methods outlined in your thesis proposal and should basically provide a detailed description of how you actually carried out your research.

Results: This chapter presents the data collected or the outcome of experiments or simulations.

Discussion: This chapter interprets and discusses the research findings, their relevance to the field, their relationship to published literature or their clinical implications (if any).

Conclusion: This closing chapter provides a recap of the problem, the main findings and the discussion including the comparison with the literature presented. It is also recommended that you include an enumerated list of your perceived contributions to the field. You may also suggest future research directions.

References: The references should be properly formatted according to a standard reference style (e.g., APA) and includes books, journal articles, monographs, dissertations and other publications.

Please consult the SGS Guidelines for Preparation of Theses at http://www.sgs.utoronto.ca/currentstudents/Pages/Formatting.aspx for the appropriate formatting of your thesis.

http://advice.writing.utoronto.ca/using-sources/how-not-to-plagiarize/
APPENDIX D - UNIVERSITY OF TORONTO FULLY AFFILIATED TEACHING HOSPITALS

1. Holland Bloorview Kids Rehabilitation Hospital
2. Centre for Addiction & Mental Health Rehabilitation
3. Hospital for Sick Children
4. Mount Sinai Hospital
5. St. Michael’s Hospital
6. Sunnybrook Health Sciences Centre
7. Toronto Baycrest Centre for Geriatric Care
8. University Health Network (including Toronto General Hospital, Toronto Western Hospital, Toronto Rehabilitation Institute, and Princess Margaret Hospital)
9. Women's College Hospital
APPENDIX E - COLLABORATING DEPARTMENTS

- Biochemistry – http://biochemistry.utoronto.ca
- Department of Chemistry – http://www.chem.utoronto.ca
- Chemical Engineering and Applied Chemistry – http://www.chem-eng.utoronto.ca
- Dentistry – http://www.utoronto.ca/dentistry
- Electrical and Computer Engineering – http://www.ece.utoronto.ca
- Laboratory Medicine and Pathobiology – http://www.lmp.facmed.utoronto.ca
- Materials Science and Engineering – http://www.mse.utoronto.ca
- Mechanical and Industrial Engineering – http://www.mie.utoronto.ca
- Medical Biophysics – http://medbio.utoronto.ca/
- Institute of Medical Science – http://www.ims.utoronto.ca/
- Pharmaceutical Sciences – http://pharmacy.utoronto.ca/programs/gradprograms.htm
- Physics – http://www.physics.utoronto.ca
- Physiology – http://www.physiology.utoronto.ca/
- Rehabilitation Science – http://www.gdrs.utoronto.ca/
APPENDIX F - GRADUATE COURSE DESCRIPTIONS

*Note: Not all courses are offered in a given year*

**BME1010/1011Y Graduate Student Seminar**
This is a series of weekly seminars given by the students on their research work. Students receive feedback on presentations from Biomedical Engineering faculty. Students will present in the series once every two years they are enrolled at the Institute. The purpose of the seminar series is four-fold. The seminar should:

1. Give students enrolled in any program in Biomedical Engineering exposure to both the breadth and depth of activities in the area.
2. Establish the identity of biomedical engineering within the student population, to the University and to funding agencies.
3. Give students an opportunity to present their work in a formal setting, and receive feedback (on both presentation style and content), prior to their thesis defense.
4. Provide a setting to maintain faculty awareness of research programs within IBBME and thereby provide a catalyst for collaborative research interactions.

Supervision committee members are required to attend their student’s presentation.

**BME 1405H Clinical Engineering Instrumentation I**
(Open to IBBME professional program students only)
This course provides a contemporary sampling of clinical technologies deployed in the continuum of health care. Recent topics include: MRI physics, Guided therapeutics, hemodialysis, clinical information technology, human factors engineering in healthcare, infusion therapy and devices, physiological pressures, laser interaction and medical device tracking. The course focuses on (1) the scientific principles underlying the clinical instrumentation, (2) the clinical applications of the technologies reviewed, and (3) merits and limitations of current technology. Lectures are given by faculty and clinical scientists who are experts in their respective areas. All lectures will take place in the teaching hospitals and may include tours of various instrumentation suites, laboratories and patient care areas. Students are evaluated on the basis of a midterm and a final exam. This course is only open to students enrolled in the Clinical Engineering Program.

**BME 1436H Clinical Engineering-Surgery**
(Open to IBBME professional program students only)
This is a unique course that consists of three components. In the first month, students attend a half-dozen didactic lectures introducing the surgical environment, basic instruments and principles of asepsis. These lectures are given by surgeons and instructors at the Surgical Skills Centre and will include a group observation of a live surgery with play by play commentary. In the second part of the course, students will attend a handful of observerships of live surgeries, at different participating hospitals. These observerships typically range from 4-8 hours. Students will be required to document a subset of surgeries, focusing particularly on technologies deployed, underlying scientific principles, their limitations, surgical workflow and ideas/designs for improvement. The final part of the course
consists of a project where each student will write a short paper on an engineering topic related to surgery. At the end of the course, students present their projects before an interdisciplinary panel of academic clinical engineers and surgeons. This course is only open to students enrolled in the Clinical Engineering Program.

**BME 1439H Clinical Engineering Instrumentation II**  
*(Open to IBBME professional program students only)*

This course continues from BME1405 and provides a contemporary sampling of clinical technologies deployed in the continuum of health care. Recent topics include: electrosurgery, metabolic measurement technology, magnetoencephalography (MEG) imaging, patient safety, radiotherapy, CT imaging, whole blood analysis, anesthesia technology and rehabilitation technologies. The course focuses on (1) the scientific principles underlying the clinical instrumentation, (2) the clinical applications of the technologies reviewed, and (3) merits and limitations of current technology. Lectures are given by faculty and clinical scientists who are experts in their respective areas. All lectures will take place in the teaching hospitals and may include tours of various instrumentation suites, laboratories or patient care areas. Students are evaluated on the basis of a midterm and a final exam. This course is only open to students enrolled in the Clinical Engineering Program.

**BME 1450H Bioengineering Science: Required course for all IBBME students**

This introductory course in Biomedical Engineering aims to provide students with:

1. A broad understanding of the research and methodologies of the core themes of IBBME;
2. Fundamental skills in research questioning, experiment design, and dissemination as needed to conduct high quality, high impact multidisciplinary research;
3. A resource-rich network to support future individual and team-based research in biomedical engineering;
4. Access to IBBME faculty through seminars and in-class discussions.

Towards these ends, the course includes a series of lectures given by guest speakers, and group discussions. These exercises explore bioengineering topics, instructional sessions on research methods and proposal writing, and multi and interdisciplinary team initiatives. The course will include elements of independent and group study. Throughout the semester, independent study will be centered on the student’s own research topic, while group study will explore an interdisciplinary biomedical research project. This research project will comprise students from across the IBBME theme areas. Finally, other miscellaneous activities will occur throughout the semester to enhance the student’s overall appreciation of Bioengineering Science.

**BME 1452H Signal Processing**

Signal processing is used throughout bioengineering both to estimate the state of life processes and to detect changes in these processes. This course introduces the modeling of signals and noise. The basics of detection and estimation theory are studied. There is a strong emphasis on classical techniques such as filtering, averaging, correlation and spectral estimation. Examples are drawn from a wide range of bioengineering problems.

**BME 1453H Cell and Tissue Engineering**
This course presents an overview of current approaches being used to control and manipulate mammalian cells for therapeutic purposes. An emphasis on how using engineering tools can be used to integrate and enhance what is known about mammalian cell behavior. Specific topics include: receptor/lig and interactions, cell adhesion, cell migration, signal transduction, cell growth and differentiation, and developmental processes. Examples and problems from gene therapy, cellular therapy, tissue engineering, and bioprocess design are used to illustrate fundamental bioengineering principals.

**BME 1454H Regenerative Medicine**
This course integrates relevant aspects of physiology, pathology, developmental biology, disease treatment, tissue engineering, and biomedical devices. The first part of the course will stress basic principles in each of these disciplines. The second portion of the course will integrate these disciplines in the context of specific organ systems. For example, the physiology of the cardiovascular system, the development of the system, cardiovascular disease, the relationship between developmental defects and adult disease, current disease treatment, cardiovascular devices, and the current progress in cardiovascular tissue engineering will be presented. The teaching material will be gathered from various textbooks and scientific journals. Whenever possible, experts in the relevant field will teach guest lectures. This integrative approach will be reflected by a problem-based learning approach to testing and a written report.

**BME 1457H Biomedical Nanotechnology**
In this course, the integration of nanotechnology with biomedical research will be discussed. The course is broken up into four sections: (1) properties of materials in the nanometer-scale and their integration with biological systems; (2) fundamental mechanisms of nanostructure assembly for the build-up of biomedical devices; (3) tools and systems for the analysis and characterization of nanoscale materials; and (4) current biomedical applications of nanomaterials.

**BME 1459H Protein Engineering**
Protein engineering has advanced significantly with the emergence of new chemical and genetic approaches. These approaches have allowed the modification and recombination of existing proteins to produce novel enzymes with industrial applications and furthermore, they have revealed the mechanisms of protein function. In this course, we will describe the fundamental concepts of engineering proteins with biological applications. A background in molecular biology is recommended.

**BME 1460H Quantitative Fluorescence Microscopy: Theory and Application to Live Cell Imaging**
Fluorescence microscopy and associated biophysical methods are integral to many areas of biological research including biomedical engineering, cell biology, and molecular biology. This course covers the theory, mechanics, and application of fluorescent microscopy. Students will gain expertise in basic and advanced quantitative fluorescence microscopy in the context of working with living samples. The course topics include sample preparation (immunofluorescence-, dye-, and fluorescent protein-labeling), multidimensional imaging, confocal microscopy, two-photon microscopy and other advanced imaging techniques. The course will also cover the associated biophysical methods used to probe live cell dynamics such as fluorescence recovery after photobleaching (FRAP), Förster resonance energy transfer (FRET), and fluorescence correlation spectroscopy (FCS). By centering on
applications to living samples, students with gain the theoretical background and practical knowledge to design and implement live cell imaging experiments. Students are expected to have a basic knowledge of cell biology.

**BME 1462H Biological Image Analysis**

Image analysis has become a central tool in modern biology. While the human eye analyzes images, its assessments are often qualitative. Computers provide quantitative, unbiased measurements, and enable the automation of the analysis, leading to a larger number of processed samples and a greater power of downstream statistical tests. In this course, we will discuss the main steps in the analysis of digital images, with an emphasis on different modalities of microscopy data, including confocal, TIRF and super-resolution. Topics will include image display, filtering, segmentation, mathematical morphology and measurements. Lectures will be complemented with examples from the current literature. Students will also have the opportunity to develop solutions to the analysis of images from their own research in a final project.

**BME 1471H Rehabilitation Engineering**

This course will introduce various state-of-the-art technologies in rehabilitation engineering. The topics will include such as functional electrical stimulation, robotics technology, deep brain stimulation, transcranial magnetic stimulation, brain-machine interfaces, and inertial sensor technology. To cover diverse research topics in the field, expert guest lecturers in each field will be invited. The physiological basis of each technique will be emphasized, to encourage students to understand fundamental principles of each technique and to seek applications in their own areas of research.

**BME 1472H Fundamentals of Neuromodulation Technology and Clinical Applications**

Electrical neuromodulation can be defined as the use of electrical nerve stimulation to control the ongoing activity of one or more neural circuits. This course will cover the fundamental topics related to electrical neuromodulation devices, such as the mammalian nervous system, neural excitation predicted by cable theory, principles of neural recording, long-term performance of implanted devices, and advanced techniques for controlling nervous tissue activation. The class will also cover selected literature of important clinical applications of electrical neuromodulation, where each student will present and lead the discussion of assigned paper(s). Finally, there will be group projects (typically consisting of 2 students) in which students will be provided a choice of topics to investigate under the guidance of the instructor or graduate student(s). The project may involve the design and testing of novel methods of nerve stimulation/recording or it may involve the implementation of neural circuits using computer software (e.g., Neuron).

**BME 1473H Acquisition and processing of bioelectric signals**

Neural signals can be used to diagnose diseases, to investigate the mechanisms by which the nervous system operates, and to control assistive devices. This course will introduce students to state-of-the-art methods in measuring the electrical activity of the nervous system. The biophysical basis of bioelectric recordings will be described, after which data collection and signal processing methods will be discussed for a range of modalities, including: electroencephalography, intracranial recordings, electromyography, electroneurography, and evoked potentials. Applications and examples will be provided for each of the techniques studied, drawn from fields including neuroscience, neurorehabilitation, kinesiology, and neurosurgery. Students will have the opportunity to apply selected methods of the course to a problem in their own areas of research.
BME 1480H Experimental Design and Multivariate Analysis In Bioengineering
In this course, students will learn to apply statistical approaches to efficiently design and analyse bioengineering experiments. The course first briefly reviews some fundamental statistical concepts related to the design and analysis of experiments (statistical distributions, the central limit theorem, linear functions of random variables and error propagation, ANOVA, multiple regression). The main topics covered include: screening designs, full factorial designs, blocking and replication, response surface methods, custom designs, sequential design strategies, non-normal responses and transformations. The students will learn to apply these statistical approaches to solve practical problems in bioengineering, in particular to examine and control the interactions of living systems with molecular and physical factors. They will also be expected to become proficient in the use of statistical software to design experiments and analyse them. Finally, the students will be expected to gain enough knowledge about experimental design strategies to be able to critically analyze the current scientific literature.

BME 1800—Biomedical Product Development I
(Open to IBBME professional program students only)
The overarching goal of this course is to be able to understand the fundamental theories behind the development of biomedical products from idea to commercial release.
At the conclusion of this course, the students should be able to:
1. Understand the theory behind the development of biomedical products from idea to commercial release
2. Apply the theory to critically analyze the relevant processes
3. Integrate the above knowledge with real world examples and solve practical problems
4. Deliver projects in a team through interactions and group projects
5. Appreciate the translational link between the fundamental concepts of biomedical engineering knowledge and its practical application in the development of commercial medical products, the processing of such products and the design considerations for clinical use of such products
This is a survey course that covers development of biomedical products from idea to commercial release.

BME 1801—Biomedical Product Development II
The objective of this course is to provide students with regulatory body and ethics considerations by which they engineer safe medical device products intended for use as implantable devices or in contact with body tissue and fluids. A top down approach will be taken where the regulatory path for product approval and associated costs with product development and validation are reviewed for different biomaterials and devices. This path is then assessed in the context of product specific reimbursement, ethics, safety, competitive positioning and regulatory concerns.

Students will be required to use their existing knowledge of biomaterials and devices, and their biocompatibility to frame the questions, challenges and opportunities with a mind to re-engineering products in order to capitalize on niche regulatory pathways. The resulting regulatory path gives a good idea of the kind of trial design the product must prevail in and ultimately the
design characteristics of the device itself. Decision making will be made with ethical considerations.

The discussion model will focus mostly on the United States regulatory office with some comments on Canada and Europe. Lastly, quantitative product development risks estimates are considered in choosing a product path strategy for proof of concept and approval of safe products. Ethical issues can also impact design since in biomedical engineering they are currently studied in the fields of bioethics, medical ethics and engineering ethics. Yet, professional ethical issues in biomedical engineering are often different from the ones traditionally discussed in these fields as they need to align with the engineering profession.

Biomedical engineers differ from medical practitioners, and are similar to other engineers, in that they are involved in research for and development of new technology, and do not engage in the study, diagnosis and treatment of patients. Biomedical engineers differ from other engineers, and are similar to medical practitioners, in that they aim to contribute to good patient care and healthcare.

The ethical responsibilities of biomedical engineers thus combine those of engineers and medical professionals, including a responsibility to adhere to general ethical standards in research and development of technology and to do R&D that adheres to the specific standards set forth by medical ethics and bioethics.

This course focuses on products currently for sale as case studies, or may be approved for sale within the next two years consistent with its practical commercial focus.

**BME 1802—Applying Human Factors to the Design of Medical Devices**

This course will apply human factors engineering principles to the design of medical devices. Testing medical devices in a health care setting, with realistic users, will be emphasized to understand why devices fail to perform adequately.

Students in this course will work in teams to complete an evaluation of a medical device design, existing prototype, or commercial product by conducting usability studies, with realistic users, to uncover use errors. Human factors engineering analysis will be used to propose and make design changes to improve the design and validation testing will be used to prove that design modifications yield a reduction in use-related errors.

Throughout the course, topics will be covered as they related to applicable medical device industry standards (e.g., quality and risk management of medical devices and usability and human factors engineering of medical devices) through lecture activities, examples, case studies, and the overarching design project.

**BME 4444Y Practice in Clinical Engineering**

*(Open to Clinical Engineering students only)*
The final evaluation of the performance of the student will be conducted by an Evaluation Committee based on a formal Intern evaluation, the Summary report of the student's experiences for each internship period, and an oral presentation of the Summary report. Clinical Engineering Practice is the management of modern health care technology. This course provides practical experience in the practice of clinical engineering. Topics to be covered include in-service education, departmental management, equipment acquisition, equipment control, equipment design, facility planning, information systems, regulatory affairs, safety program, system analysis and technology assessment/evaluation.

**DEN 1070H Advances in Dental Materials Science**
This course presents a comprehensive review of the developments occurring in dental biomaterials research, under three main themes: Materials Processing and Technologies; Material/Biological Interfaces; and Clinical Applications and Associated Biomaterial Issues. There will be no formal reports or exams in this course, however the research ability of the graduate students will be assessed throughout the term based on three criteria: 1) the ability to identify clinical and/or scientific problems; 2) the proposal of a viable plan to study the problems; and 3) the ability to defend their plan.

**DEN 1081H Bone Interfacing Implants**
This course discusses the concept of the bone/implant interface by combining the multi disciplinary approach necessary to understand both the material and biological aspects of the interface. All materials currently used in bone implants are treated from a surface science perspective together with the activities of both major types of bone cells; osteoblasts and osteoclasts. The cell’s biological aspects of the interface are covered within the context of explaining the tissue arrangements found at bone implant surfaces.

**JCB 1349H Molecular Assemblies: Structure/Function/Properties**
This course will focus on the mechanisms associated with the assembly of molecular and biomolecular systems, including colloids, small molecule organic crystals, and protein complexes. The goal of the course is to foster an understanding of the subtle interactions that influence the process of assembly, which has wide ranging implications in fields ranging from materials science to structural biology. Examples will be drawn from the current literature encompassing studies of self-assembly in solution, at surfaces, and into the solid state. Supplementary reading and a term project targeting some aspect of molecular assembly will be assigned.

**JEB 1365H Ultrasound: Theory and Applications in Biology and Medicine**
Following a brief historical review, wave propagation from simple structures is examined with the help of the Rayleigh-Sommerfeld diffraction equations. The Rayleigh integral is obtained and applied for determining both the transient and steady-state radiation characteristics from a variety of sources. The theory of ultrasound scattering is developed and applied for understanding scattering by soft tissue, including blood. This is followed by the design and characterization of transmitting and receiving transducers. Included, is a consideration of materials, models and methods for experimental evaluation of performance. The design and properties of B-mode imaging arrays are described along with their practical application. Doppler ultrasound for flow assessment and flow imaging, spectral analysis of
Doppler signals and related methods are also described. Those attending the course will be provided with a book in CDR form that is currently being prepared for publication.

**JEB 1433H Medical Imaging**
Linear analysis of imaging systems. Basic physical principles of Ultrasound, X-ray and Magnetic Resonance Imaging with a laboratory assignment on each modality. (Same as BME 595F, PHY 445H).

**JEB 1444H Neural Engineering**
General perspective of neural engineering and neurobiology; biological neural networks; parametric neural models using rate processes; nonparametric neural models, using the Volterra-Wiener approach; artificial neural networks as nonparametric neural models.

**JEB 1447H Sensory Communications**

**JPB 1022H Human Physiology as Related to Bioengineering**
This course introduces engineering students with a physical background to the basic concepts of human physiology and provides an overview of multiple systems at the organ, tissue and cellular levels. Systems discussed include the nervous, cardiovascular, respiratory, renal, endocrine and skeletal systems. Discussions/presentations of current literature will include application of bioengineering methodologies to the aforementioned systems. The course stresses breadth rather than depth and although there are no defined prerequisites, students should have a minimum background equivalent to high school biology. If you have taken biology beyond a first year undergraduate level you should not take this course. This is a graduate level course that is taught at an accelerated pace and requires considerable time beyond lecture to review the required material.

**JPB 1055H Bioengineering for Life Scientists**
This course incorporates lectures and laboratories from other courses, which may be supplemented by reading, lab assignments, and special lectures. Approval by the course Coordinator is required. This course consists of course(s) in core engineering subjects, and enrichment arranged with course Coordinator. Graduate students wishing to register for this course should see Professor Dolan as soon as possible after September 1. The enrichment may be a project, report, or major laboratory exercise.
**Prerequisites:** Mathematics at second-year undergraduate level (calculus, complex variables, transforms); some background in physics.

**JTC1331F Biomaterials Science**
An introduction to the various sciences underlying the use of materials in medicine (i.e. biomaterials) with particular emphasis on the interface between biological media and synthetic tissues. Instructors come from a variety of Graduate Departments and Institutes including Chemical Engineering and
Applied Chemistry, Metallurgy and Materials Science, Biomedical Engineering, Dentistry and Pathology. Additional lectures may be provided by individuals from other universities (e.g. McMaster University). Topics to be covered include: surface physics and analysis, principles of protein adsorption and cell growth on materials, structure and function of key tissues (bone, blood, etc.), principles of tissue responses to biomaterial implantation (toxicity, foreign body reaction).

**Prerequisite: physical science/engineering background with some knowledge of materials science of biomaterials.**

**PSL 1431H Mathematics for Physiology**

A selection of topics in mathematics and computer science that are applicable in physiology. The content of the course changes from year to year. The student will be expected to learn the elements of computer programming, with a view to the design and analysis of experiments, and the theoretical analysis of measured data. The remainder of the lectures will deal largely with the solution of ordinary differential equations, with emphasis on those equations that are encountered most commonly in the biological sciences. Elementary numerical solution of differential equations. Introduction to the Laplace transform and the use of linear systems theory in physiology. The elements of curve fitting.

**Prerequisites: Second year calculus is mandatory. Some background in biology/physiology is desirable. Problem sets require some biological knowledge.**

**PSL 1432H Theoretical Physiology**

An introduction to the computational principles of learning. Topics include simulating sensorimotor systems, computational powers of neural networks, error-driven learning, correlation-based learning algorithms, backpropagation, recurrent networks, and adaptive control. The course will consist of twelve two-hour lectures.
APPENDIX G - COURSE REQUIREMENT ALTERNATIVES

Sample of courses that may meet the Life Sciences requirement for engineers and Physical scientists are:

- BCH1426H Signal Regulating Metabolic Pathways
- BCH2029H Protein Folding: Principles and Diseases
- BME 1453H Cell and Tissue Engineering
- BME 1454H Regenerative Medicine: Fundamentals & Applications
- DEN1080Y Biology of Connective Tissues
- DEN1081H Bone Interfacing Implants
- JPB 1022H Human Physiology as Related to Bioengineering
- JTP 2010H Proteomics and Functional Genomics
- JYG1555H Advanced Topics: Cellular and Molecular Neurobiology
- LMP1404H Molecular & Cellular Mechanisms of Disease
- LMP1503H Signal Transduction Pathways in Normal and Diseased Tissues
- MBP 1007H Fundamentals in Molecular & Cell Biology I
- MBP 1008H Fundamentals in Molecular & Cell Biology II
- MBP 1018Y Oncology
- MBP 1022H Advanced Cell Biology for Physical Scientists
- MBP10266H Clinical Imaging for Physical Scientists
- MSC1006H Introduction to Anatomical Organization of the Brain
- PHY2704H F Cellular Dynamics
- PSL1026H Advanced Topics: Experimental Cell Physiology
- PSL1452H Fundamental of Ion Channel Function
- PSL1047H Advanced Topics: Somatosensory & Pain Neuroscience
- PSL1075H Biology in Time
- PSL1441H Systems Level Neuroplasticity
- REH1510H Disordered and Restorative Motor Control

Sample of courses that may meet the Engineering and Physical Sciences requirement for Life scientists are:
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCH425H</td>
<td>Structural Biology: Principles and Practice</td>
</tr>
<tr>
<td>/ JBB1425</td>
<td></td>
</tr>
<tr>
<td>BME1452H</td>
<td>Signal Processing</td>
</tr>
<tr>
<td>BME 1453H</td>
<td>Cell and Tissue Engineering</td>
</tr>
<tr>
<td>BME 1457H</td>
<td>Biomedical Nanotechnology</td>
</tr>
<tr>
<td>BME1458H</td>
<td>Pattern Discovery Methods for Biomedical Engineering</td>
</tr>
<tr>
<td>BME1472H</td>
<td>Fundamentals of Neuromodulation Technology and Clinical Applications</td>
</tr>
<tr>
<td>BME1473H</td>
<td>Acquisition and Processing of Bioelectric Signals</td>
</tr>
<tr>
<td>BME 1480H</td>
<td>Experimental Design and Multivariate Analysis in Bioengineering</td>
</tr>
<tr>
<td>CSC2515H</td>
<td>Introduction to Machine Learning</td>
</tr>
<tr>
<td>DEN1070H</td>
<td>Advances in Dental Materials Science</td>
</tr>
<tr>
<td>DEN1082H</td>
<td>Biomaterials for Implant Treatment in Dentistry</td>
</tr>
<tr>
<td>ECE1774H</td>
<td>Sensory Cybernetics</td>
</tr>
<tr>
<td>JCB 1349H</td>
<td>Molecular Assemblies: Structure/Function/Properties</td>
</tr>
<tr>
<td>JEB 1365H:</td>
<td>Ultrasound: Theory and Applications in Biology and Medicine</td>
</tr>
<tr>
<td>JEB1433H</td>
<td>Medical Imaging</td>
</tr>
<tr>
<td>JEB 1444H</td>
<td>Neural Engineering</td>
</tr>
<tr>
<td>JMB 1050H</td>
<td>Biological Materials</td>
</tr>
<tr>
<td>JPB 1055H</td>
<td>Bioengineering</td>
</tr>
<tr>
<td>MIE 1420H</td>
<td>Experimental Methods in Human Factors Research</td>
</tr>
</tbody>
</table>
### APPENDIX H - EXAMPLES OF COURSE ALTERNATIVES (NON BME COURSES)

**Theme area: Tissue Engineering, Biomaterials and Regenerative Medicine**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSC7000Y</td>
<td>Regenerative Medicine</td>
</tr>
<tr>
<td>JTC1331H</td>
<td>Biomaterials Science.</td>
</tr>
<tr>
<td>JNR1444Y</td>
<td>Neuroscience</td>
</tr>
<tr>
<td>CHE1310</td>
<td>Chemical Properties of Polymers</td>
</tr>
<tr>
<td>PSL1040H</td>
<td>Systems biology in physiology</td>
</tr>
<tr>
<td>ECE1656H</td>
<td>Non linear modeling and analysis of biological systems</td>
</tr>
<tr>
<td>DEN1080Y</td>
<td>Biology of Connective Tissues</td>
</tr>
<tr>
<td>DEN1081H</td>
<td>Bone Interfacing Implants</td>
</tr>
<tr>
<td>MSC3001H</td>
<td>Foundations in Musculoskeletal Science</td>
</tr>
<tr>
<td>JNR1444Y</td>
<td>Fundamentals of Neuroscience: Cellular and Molecular (very advanced)</td>
</tr>
<tr>
<td>PSL1441H</td>
<td>Systems Level Neuroplasticity</td>
</tr>
<tr>
<td>PSL1445H</td>
<td>Mechanistic Molecular &amp; Cellular Neuroscience</td>
</tr>
<tr>
<td>PSL1452H</td>
<td>Fundamentals of Ion Channel Function</td>
</tr>
<tr>
<td>PSL1462H</td>
<td>Molecular Aspects of Cardiovascular Function (<strong>has prerequisite therefore some students may not be eligible</strong>)</td>
</tr>
<tr>
<td>JYG1555H</td>
<td>Advanced Topics – Cell and Molecular Neurobiology</td>
</tr>
<tr>
<td>JCV1060H</td>
<td>Developmental Cardiovascular Physiology</td>
</tr>
<tr>
<td>JCV3060H</td>
<td>Advanced Topics in Cardiovascular Science: Molecular Biology and Heart Signal Transduction</td>
</tr>
<tr>
<td>JCV3062H</td>
<td>Advanced Topics in Cardiovascular Science: Heart Function</td>
</tr>
<tr>
<td>JCV3063H</td>
<td>Advanced Topics in Cardiovascular Science: Vascular</td>
</tr>
</tbody>
</table>
Theme area: Nanotechnology, Molecular Imaging and Systems biology

PHY2701 Biological Physics

PHY2703 Molecular Biophysics

PHY2703 Cellular Biophysics

PHY2704 Cellular Dynamics

Theme area: Neural, Sensory systems, Rehab

JNS1000Y “Fundamentals of Neuroscience: Systems and Behaviour”

CSC 2515 - Introduction to machine learning

CSC2535 – Advanced machine learning (usually after CSC2515 but not necessarily)

PSY5110HS – Rhythms of the Brain in Cognition and Pathologies

PSY5123HF Cognitive Rehabilitation

REH 1120H Research methods for rehabilitation science

REH 1510H Disordered and restorative motor control

MIE 1807J Principles of measurements

Theme area: Engineering in a clinical setting

CSC 2514H Human-Computer Interaction

INF 1230H Management of Information Organizations

INF 1341H Analyzing Information Systems

INF 1342H Designing Information Systems

INF 1343H Data Modeling and Database Design

INF 2149H Administrative Decision-Making in Information Organizations

INF 2150H Advanced Management of Information Organizations

INF 2164H Authority and Credibility in Online Communications

INF 2169H User-Centred Information Systems Development
INF 2183H  Knowledge Management and Systems
INF 2241H  Critical Making: Information Studies, Social Values and Physical Computing
KMD1001  KMD: Fundamental Concepts
KMD1002  KMD: Contexts and Practice
KMD2001  Human-Centred Design
KMD2002  Technologies for Knowledge Media
KMD2003  Technology in Education: Philosophical Issues
KMD2004  Knowledge Media, Culture & Society
KMD4000 — Special Topics in KMD
MIE 1402H  Experimental Methods in Human Factors Research
MIE 1403H  Analytical Methods in Human Factors Research
MIE 1407H  Engineering Psychology and Human Performance
MIE 1411H  Design of Work Places
MIE 1412H  Human-Automation Interaction
MIE1413H  Statistical Models in Empirical Research
MIE1414H  Human Factors in Transportation
MIE1415H  Analysis and Design of Cognitive Work
MIE542H1  Human Factors Integration
MIE1616H  Research Topics in Healthcare Engineering
MSL 2325H  Museums and New Media Practice
SOC 6312H  Social Aspects of Technology and Work
SOC 6501H  Research Design and Hypothesis Testing