Institute of Biomaterials & Biomedical Engineering
UNIVERSITY OF TORONTO

Innovation, Hammer and Nails – Institute of Biomaterials and Biomedical Engineering Terms of Reference

Innovation, Hammer and Nails is an initiative between the Hospital for Sick Children and the Institute of Biomaterials and Biomedical Engineering. The Innovation, Hammers & Nails program seeks to connect students in Biomedical Engineering with clinicians, nurses, staff & fellows at the Hospital for Sick Children to design solutions for problems and challenges identified by experts at the hospital. IBBME will utilize existing courses and programs to facilitate these interactions.

IBBME Undergraduate & Graduate Opportunities:

BME489F - Biomedical Systems Engineering Design	
Course Description	A capstone design project that provides 4th year students in the Biomedical Systems Engineering major with an opportunity to integrate and apply their technical knowledge and communication skills to solve real-world biomedical engineering design challenges. Students will work in small groups on projects that evolve from clinical partners, biomedical/clinical research and teaching labs, and commercial partners. At the end of the course, students present their work orally during the Biodesign Fair and submit a final design report.
Project Dates	September 2015 – December 2015
Course Coordinator	Professors Rodrigo Fernandez-Gonzalez, Jan Andrysek and Moshe Eizenman
Client/Stakeholder Expectations	This course requires stakeholders who can provide problems and any necessary expertise in their area of work. Students work for the client to create a prototype of the device to solve a medical need.
IBBME Funding	$500 – 750 per student group
IBBME Resources	IBBME Undergraduate Teaching Laboratory (Mining Building Room 325) IBBME Undergraduate Design Studio (Mining Building Room 64)
BME498Y – Biomedical Engineering Capstone Design	
Course Description	In this project-based design course, teams of students from diverse engineering disciplines (enrolled in 4th year of the Biomedical Engineering Minor) will engage in the biomedical technology design process to identify, invent, and implement solutions to unmet clinical needs. The students will learn about medical technology development and will engage in the process through lectures, guest lectures delivered by medical technology experts, "hands-on" practicums, and a student-led design project. Students work to create a prototype.
Project Dates	September/October 2015 – April 2016
Course Coordinator	Professor Jan Andrysek & Dr. Sabine Weyand
Client/Stakeholder Expectations	This course requires stakeholders who can provide problems and expertise in their area of work. Students in this course would benefit from clinical observation to create a better needs assessment. Once they have identified a problem, the clinician would act as a mentor to provide expertise in their field.
IBBME Funding	$500 – 750 per student group
IBBME Resources	IBBME Undergraduate Teaching Laboratory (Mining Building Room 325) IBBME Undergraduate Design Studio (Mining Building Room 64)

BME499Y – Applied Research in Biomedical Engineering	
Course Description	This course provides the opportunity for 4th year Biomedical Engineering Minor students to gain hands-on exposure and experience in dynamic biomedical research environments. Students are required to perform two modules - one is completed in the Fall semester, and the second is completed in the Winter semester. Each module will provide a minimum of 90 hours of hands-on activity. Students will select opportunities with faculty in laboratories classified within two (of the four) different themes at the Institute of Biomaterials and Biomedical Engineering (IBBME). Activities will provide exposure to experimental design, the use of analytical equipment, and assessment of relevant literature (scientific, patent, and regulatory) related to the research topic identified by the faculty member.
Project Dates	September 2015 – December 2015 January 2016 – April 2016
Course Coordinator	Professor Christopher Yip & Dr. Dawn Kilkenny
Client/Stakeholder Expectations	Clinicians would act as a co-supervisor to students, providing the area of concentration for their research and practical application to their research.
IBBME Funding	None
IBBME Resources	IBBME Co-Supervisor
IBBME Undergraduate Summer Research Program	
Program Description	The Undergraduate Summer Research Program is a 16 week program (May to mid-August) that presents an opportunity for students to work independently or in a group in a research environment, as well as participate in a variety of biomedical engineering workshops, career talks, and events. The experience culminates with a mini-symposium where students present their research to their fellow students and faculty. The expectation is that students are paid a stipend of no less than $4800 for their work.
Project Dates	May 2016 – August 2016
Program Coordinator	Dr. Dawn Kilkenny
Client/Stakeholder Expectations	Clinicians would act as a co-supervisor to students providing the area of concentration for, and practical application of, their research. This experience could also be a specific project that the student would complete over the summer months.
IBBME Funding	Director Summer Research Opportunity (DSRO - $2400) or Undergraduate Research Opportunity Program (UROP - $2400) awards are available; these awards are not guaranteed.
IBBME Resources	IBBME Co-supervisor
Departmental 4th Year Thesis Courses	
Program Description	These courses provide an opportunity for students to conduct, document, and experience independent engineering research under the supervision of a faculty member.
Project Dates	September 2015 – April 2016
Program Coordinator	Dependent upon department/division
Client/Stakeholder Expectations	Clinicians would act as a co-supervisor to students, providing the area of concentration for their research and practical application to their research.
IBBME Funding	None.
IBBME Resources	IBBME Co-supervisor

Masters of Health Science in Clinical Engineering	
Program Description	The Clinical Engineering Master of Health Science is a two-year, full time program consisting of academic courses, internships and a research thesis. Through a balanced combination of instruction, interdisciplinary research and practical hands-on training, the program prepares talented engineers to innovate new solutions to clinical challenges, to enhance patient safety, and to optimize the delivery, integration and management of contemporary technology-mediated healthcare. The expectation is that students are paid a stipend of $11,965 (year 1) and $10,465 (year 2) for their work.
Project Dates	September 2015 (2 year Masters)
Program Coordinator	Professor Jan Andrysek
Client/Stakeholder Expectations	Surgeons who have a University of Toronto appointment can act as a co-supervisor for a Clinical Engineering student (alongside an appointed IBBME faculty member). As their co-supervisor, they would act as the guide for students to complete a MHSc thesis.
IBBME Funding	$3000 fellowship
IBBME Resources	IBBME Co-supervisor
Masters of Health Science in Clinical Engineering – Internship	
Program Description	One of the most unique and exciting components of the Clinical Engineering Program is the opportunity to acquire practical experience and knowledge through a series of internship placements. Students in the program are required to complete a minimum of 1225 internship hours, comprising of 3 internships. Up to two internships can be served with one employer (thus a total of just over 800 hours). Typically, students are paid around $15/hour, although other arrangements may be possible. Placements range from opportunities in local medical device industries and hospitals, to international placements with the World Health Organization and leading healthcare manufacturers worldwide.
Project Dates	Variable; full time (4 months), or part time (8 – 24 months)
Program Coordinator	Professor Jan Andrysek
Client/Stakeholder Expectations	The Hospital for Sick Children would employ the student as an intern to complete the desired project. The internship is a required part of a course, the employer is asked to complete an evaluation of the student upon completion of the internship.
IBBME Funding	None
IBBME Resources	Administrative Assistance
Masters of Engineering – Internship (BME1899: Internship in Applied Research)	
Program Description	The M.Eng. is a new graduate program starting in Fall 2016. This program will focus on biomedical device development (specifically biomedical sciences, engineering design and entrepreneurship). The program requirements include an internship in applied research which can be done in industry, a hospital or in an academic research laboratory. Through this internship, students will be exposed to at least one of the four applied research fields in IBBME (Neural/Sensory Systems Rehabilitation; Biomaterials, Tissue Engineering and Regenerative Medicine; Nanotechnology, Molecular Imaging and Systems Biology; Engineering in a Clinical Setting).

	It is expected that students will cover four important aspects of biomedical device development during their internship: 1. Clinical, medical or health needs assessment (need of healthcare providers, and patients). 2. Concept development (literature and patent searches, input from experts). 3. Design and prototyping. 4. Development of business models. Note: the aspects listed above will apply concepts related to courses from their M.Eng. program.
Project Dates	May – September (4 months, full time) (note that the development of the project proposal should start 8 months before the actual internship)
Program Coordinator	Professor Julie Audet
Client/Stakeholder Expectations	The Hospital for Sick Children would employ the student as an intern to complete the desired project. The internship is a required part of a course, the employer is asked to complete an evaluation of the student upon completion of the internship.
IBBME Funding	None
IBBME Resources	Administrative Assistance

Pairing of Projects:

The Hammers & Nails committee will determine which projects and IBBME opportunities are best matched. The committee will meet two to three times per year to determine pairings. Meetings should take place in: Late July/early August, November, and March.

Expectations of Students & Tracking:

The expectations of students are clearly defined within each course, degree, and program and will vary between students/student groups depending on their program of affiliation with Hammers & Nails. University of Toronto instructors, administrative staff and academic coordinators are in charge of ensuring that students abide by the expectations laid out to them as part of their course, degree, or program. Clinicians working with students may be asked to provide specific feedback with regards to the student's performance as part of the generation of a review or mark for the student's course requirements. This expectation will be clearly outlined to the Clinician prior to the start of their working relationship with the students. IBBME will provide general tracking of number of students, and projects that have been associated with Hammers & Nails which will then be forwarded to the Hammers & Nails committee once per year.

Membership of the Innovation, Hammers and Nails:
The Hammers and Nails committee is comprised of

- Dr. Christopher Caldarone, Chief of Perioperative Services, The Hospital for Sick Children
- Dr. Vito Forte, The Hospital for Sick Children
- Dr Jason Maynes, The Hospital for Sick Children
- Professor Christopher Yip, Director, IBBME
- Dr. Dawn Kilkenny, Associate Director, Undergraduate, IBBME