BME 489F: Biomedical Systems Engineering Design

1. Calendar Information

A capstone design project that provides students in the Biomedical Systems Engineering option 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 teams on projects that evolve from clinical partners, biomedical/clinical research and teaching labs, and commercial partners. At the end of the course, students submit a final design report and a poster for public exhibition. Course Description Reference:
http://www.ibbme.utoronto.ca/students/graduate/current/courses/descriptions/

2. Course Overview

BME489 is a capstone design project course intended to give students an opportunity to apply their technical knowledge and communication skills to tackle complex, open-ended design problems in a realistic environment. These design problems are proposed by 'client' partners based in clinical and/or research labs. Working in teams of three to five, students develop a design project from an initial concept to a final working prototype. Each team will be assigned a project supervisor (i.e., one of the teaching assistants) who should be included in all communication with the project client. The proposal, presentation, and report will be evaluated by the project supervisor and the course coordinators. Each team is also responsible for initiating contact with their client and communicating with them throughout the course in a professional manner. At a minimum, each team should strive to communicate with their client by: 1) having an initial meeting, 2) presenting their proposal (if possible, in person), and 3) demonstrating how their final prototype functions (if possible, in person). Students are expected to have sufficient technical background that they can successfully address the design challenge with additional self-study. The goal is to assess the student's capacity to practice innovation, entrepreneurial initiative, and engineering design within a biomedical context resulting in a functional prototype that meets a set of pre-defined technical specifications.

3. Learning Outcomes and Graduate Attributes

At the end of this course, you will be able to:
1. Describe a credible and professionally acceptable approach to "engineering design"
2. Summarize and justify design choices in oral and written formats
3. Apply previous knowledge and skills to open-ended design problems
4. Plan and manage engineering activities to within time and budget constraints
5. Develop a functioning engineering prototype of a product or service
6. Document an engineering design in a form suitable for clients to continue project

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4. Timetable

Section	Day of the Week	Start Time	Duration (Minutes)	Location
Practicum	Monday	09:00	180	MB78/64
Lecture	Tuesday	16:00	60	MY360
Tutorial	Tuesday	17:00	60	MY360

Office Hours: https://calendly.com/chris-bouwmeester/fall2018-office-hours

5. Teaching Team

Instructors

Name	Phone	Office	Email
Chris Bouwmeester	(416) 978-3702	MB321A	chris.bouwmeester@utoronto.ca

Prof. Bouwmeester is be the main point of contact for students and is responsible for evaluating and providing feedback (focused on the design process) to students.

Innovation, Hammers & Nails Liaison Officer

Name	Phone	Office	Email
Dr. Vito Forte	(416) 813-6846	6278A Burton Wing	vito.forte@sickkids.ca

Dr. Forte is the Innovation, Hammers & Nails liaison and his primary role is connecting clients at SickKids with your team. In this role he may attend some SickKids client meetings. He will also give feedback from a clinical perspective at the progress and final presentations.

Teaching Assistants – Project Supervisors

Name	Phone	Office	Email
Arushri Swarup			arushri.swarup@mail.utoronto.ca
Karly Franz			karly.franz@mail.utoronto.ca

Ms. Swarup and Ms. Franz will be available to individual teams as they will be present in the design studio to help you with technical aspects of your design projects. In their role as project supervisor they will be linked with individual teams and be the first person that students should turn to for help. In this way they are a bridge between the course instructors and the individual teams. As such, they will attend all of your team meetings to monitor how well individuals are functioning as part of a team and provide evaluations of your team engagement as well as written and oral deliverables.

Communication Instructor

Name	Phone	Office	Email
Nikita Dawe			nikita.dawe@mail.utoronto.ca

Ms. Dawe will provide support and feedback regarding your written and oral communications. She will provide feedback on your engineering communication specifically for the project proposal to enable your improvement for the final report. She will also give you feedback on a practice oral presentation before your final presentation to clients and your fellow students.

6.   Final Grade Determination

The final grade in this course will be based on the following components:

Component	Learning Outcome(s) Evaluated	Due Date	Weight	
Progress presentations (individual)	1, 2, 6	See schedule	5	%
Project proposal (team)	1 – 7, 9	Oct 16	20	%
Design review with client (team)	2	Nov. 6	5	%
Final presentation (team/individual)	1, 2, 6	Dec 4	15	%
Final report (team)	1 – 9	Dec 5	30	%
Design Portfolio (individual)	1 – 3, 5, 6	Dec 5	15	%
Progress Documentation [Client and Team meetings]	1 – 9	See schedule	10	%

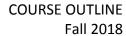|			
Total:		100	%

7.   Deliverables

All written submissions must be received by 11:59 PM on the date listed. Additional details related to each deliverable are given in guideline documents posted in the submission section in Quercus.

Progress Presentations

Your attendance is mandatory for all progress report dates and absences may result in less than full marks. Each individual must present a 3-minute update to show their progress followed by questions posed by the teaching team. Every member of each team must present at least once and if there is a team of 4, one person must present twice. As an individual presenter, your goal is to present your progress clearly and succinctly (if there was no progress, the presenter will discuss the technical hurdles encountered and the plan to overcome them). For the team, the goal is to monitor progress and to detect problems early and to get feedback from the teaching team and the other student teams. Each individual will receive full marks for presenting a progress report for their team and attending all other progress reports that they do not present personally.

Project Proposal

The purpose of the proposal is to submit a document to the teaching team that: 1) defines the design problem, 2) proposes possible solutions and selects the most promising design, and 3)

provides a plan to carry out the proposed solution. Please refer to *'Guidelines for Project Proposal'* (posted on Quercus) for more information.

You must also submit the proposal to your client and, if possible set, up a meeting with them to communicate your proposal clearly and succinctly.

Design Review with Client

You must schedule a face-to-face meeting with your client soon after you submit your proposal document. In this meeting you should demonstrate your preliminary prototypes and discuss your proposal. The format is at the discretion of you and your client but you will be required to submit a written copy of the feedback provided to you by your client and a list of actions items that you can accomplish to address any deficiencies in your proposed design.

Final Report

Your team must produce a final report that provides your client all the information they need to develop your project. While much of the project proposal can be reused, you are expected to incorporate feedback from your client, project supervisors, and fellow students to demonstrate you have iterated your original goals, ideas, concepts, designs, etc. Please refer to *'Guidelines for Project Report'* (posted on Quercus) for more information.

Final Presentation

This is your major opportunity to demonstrate your prototype development process to the teaching team and your peers. The aim of this presentation is to demonstrate that you have created a solution works to your client (taking into consideration the context of this course) and describe the process you used to your project supervisors. It is highly recommended that you invite your client to the final presentations. If your client does cannot attend in person, it is expected that you will schedule a time with your client to present your prototype and project face-to-face. Please refer to *'Guidelines for Project Presentations'* (posted on Quercus) for more information.

Design Portfolio

The purpose of the design portfolio is to showcase your knowledge, abilities, and experiences in this course. This artifact will document the work you have done individually or in collaboration with your teammates. Relevant material may include: brainstorming outcomes, doodles, sketches, drawings, interview transcripts, video observations, test results, etc. While it is expected that there will be overlap between teammates using similar content, each individual's portfolio must be a reflection of your individual experiences and narrative. The artifacts you include in your portfolio require context. At the highest level, this can include a statement of design approach, where you may outline your personal priorities and values as they relate to engineering design (e.g., sustainability, human factors, etc.)

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Progress Documentation

You are expected to engage with your client and project supervisor in a professional manner in all aspects of communication. Each team is responsible for setting up meetings with their client and be responsible for conducting and documenting team meetings. The minimum expectation is that every client meeting and team meeting (scheduled during tutorials) is recorded. After each week there is a team meeting scheduled during tutorials you must submit your complete collection of meeting documentation to that date – i.e., your final submission should be a collection of a meeting documentation that occurred during the whole semester. You have the freedom to choose your format or platform for meeting documentation but it must be submitted electronically. Best practice is to distribute an agenda prior to a meeting and record all feedback and agreements made during meetings. Please refer to *'Guidelines for Meeting Documentation'* (posted on Quercus) for more information on professional meeting documentation.

8. Textbook

There are no formal textbooks for this course. However, you may find the Biodesign textbook and the large amount of online resources (http://ebiodesign.org/) helpful. You may also find other design textbooks listed below are helpful to you during the design process.

Title	Biodesign – The Process of Innovating Medical Technologies
Author(s)	Yock, Zenios, Makower, Brinton, Kumar, Watkins, Denend
Edition, Year	2nd Edition (2015)
Publisher	Cambridge University Press

Title	The Mechanical Design Process
Author(s)	Ullman
Edition, Year	5th (2016)
Publisher	McGraw Hill

Title	Designing Engineers – An Introductory Text
Author(s)	McCahan, Anderson, Kortschot, Weiss, Woodhouse
Edition, Year	1st (2015)
Publisher	Wiley

9. Course Policies

Accommodations for Disabilities

Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability and/or health consideration that may require accommodations, please feel free to approach me and/or Accessibility Services at (416) 978-8060 (accessibility.utoronto.ca).

Lateness Policy

Graded assignments received later than the due date posted will be awarded a 10% deduction compounded for every day that the submission is late. Exceptions may be accommodated for valid reasons (such as severe illness or compassionate grounds), that are out of a student's control, and may be considered if supported by written documentation. Examples of invalid reasons would include situations where Quercus submissions were not executed properly by a student, or a student forgot the deadline.

Attendance Policy

While no notification of your absence is necessary for the course instructor, if you are absent, you will be responsible for gathering the information you need from your peers or communicating with your project supervisor or team members. In the case of the progress presentation that you must deliver, you should coordinate with you team to ensure you will be able to present. If you have a time conflict with one of the mandatory progress report dates that cannot be avoided (e.g., religious obligation) you must notify the instructor beforehand to make possible alternative arrangements.

Online Communication Policy

All course-related questions should be posted in the "Course Q & A" discussion. If you have a question you should: 1) check the syllabus or guidelines for your answer, 2) check the Course Q & A discussion to see if your question has already been answered, or 3) ask a peer directly. Every attempt will be made to respond within 3 business days to posts that need the attention of the corresponding TA. If necessary, you may email the corresponding TA (or instructor, if absolutely necessary) regarding personal issues that may impact this course. BME489 must be used at the beginning of the subject line to ensure prompt response to emails. Every attempt will be made to responded to emails within 3 business days.

Academic Integrity Message

Plagiarism is taken very seriously and as per the code of behaviour on academic matters: "it is the students' responsibility to know what constitutes an academic offense". As per University of Toronto guidelines: "You need to integrate your acknowledgements into what you're saying. Give the reference as soon as you've mentioned the idea you're using, not just at the end of the paragraph. It's often a good idea to name the authors ("X says" and "Y argues against X,") and then indicate your own stand ("A more inclusive perspective, however, … ")". Specific instructions on bibliography formats will be given in assignment guideline documents but as a general rule; it is not acceptable to rely on Wikipedia or Google rather than library resources. For more information, please see (www.writing.utoronto.ca/advice/using-sources/how-not-to-plagiarize) for a practical guide and the following links for more information on University of Toronto policies: (http://academicintegrity.utoronto.ca/) (http://www.governingcouncil.utoronto.ca/Assets/Governing+Council+Digital+Assets/Policies/PDF/ppjun011995.pdf).

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10.   Additional Course Information

Project Pitch Night: Sept 11; 16:00 – 18:00, MY360

Project clients will present their projects during an interactive event where you are encouraged to ask questions to help your team choose your project. Potential clients will present their projects and answer questions. Brief project descriptions will be posted in advance to enable you to come prepared with questions for particular projects you are interested in selecting.

Project Selection / Client Matching

After the completion of the pitch night, each team will select their top 3 project preferences. A short 1 sentence description should be given with your #1 choice that answers the question: "Why is your team the best match for this project?" Every effort will be made to match every team with their top choice. However, an equal distribution of projects amongst clients and a team's answer to the above question may also be considered to match each team with a client.

Grading

Final grades of the project proposal and final report and presentation will be determined with a consensus of the teaching team. Clients will only evaluate your project holistically as a part of the design review and final presentation.

Project budget

Up to $500/team is provided to each team. An itemized budget will be included with the proposal and will need to be approved by the project supervisor before funds greater than $100 are reimbursed. Additional funds (up to $1000 total) may be approved if a strong justification is made to the course coordinator. Teams requesting extra funds will need to write a one-page grant application justifying the need for the additional funds.

Design Studio

IBBME safety policy requires that all students take part in safety training prior to using the Design Studio. This has been scheduled for September 10, in two blocks of time to accommodate all students. You must register in advance for one of the time slots. If students do NOT pass the safety test, they will be given one additional opportunity to rewrite and pass the test. The Design Studio introduction, safety presentation, and quiz should only take 30 minutes. A teaching assistant will be available every week during practicum time to answer questions or help you with your projects. The design studio will only be available during practicum time (i.e., Mondays from 9 – 12) but you may also be able to connect with the design studio facility at the Myhal Centre to work on your project outside of this time.

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Teaching Lab

The IBBME Teaching Lab is also reserved for students in BME489 who need access to wet lab facilities. **There will be a mandatory training session for students who need access to the Teaching Lab.** To use this facility, you must contact the teaching lab coordinator at teachinglab.ibbme@utoronto.ca.

Awards

- John W. Senders ($1,000)
  "For imaginative and successful application of engineering to the design of a medical device capable in generality of its application to restore normal human function." This award is decided by the Faculty-wide, Multidisciplinary Capstone Design committee.
- IBBME Director's Biodesign Award ($500)
  "To the best BME489/BME498 project." Decided by the IBBME Director.

Bonus Marks

You may choose to provide documentation that could be used as a submission to a relevant student design competition for bonus marks. A maximum of 2% bonus is available if you choose to do this extra work. Please see *'Guidelines for Bonus Marks'* (posted on Quercus) for more information.