
Course Syllabus

Course Information

GBM 6952: Special Course in Biomedical Engineering: Organ-On-Chip Technology- Credits: 2, Winter 2020

Eligibility: Graduate and final year undergraduate students from the University of Montreal, Polytechnique of Montreal and affiliated hospital research centers. It is also available for students from other universities through the bureau de collaboration interuniversitaire (BCI).

Location: Hybrid (in class & online)

Time: Wednesdays 2-4 p.m.

Course language: English

Final: 2:00 p.m. Wednesday, April. 20th

Professor Contact Information

Prof. Houman Savoji,

Assistant Research Professor,

Institute of Biomedical Engineering,

Department of Pharmacology and Physiology,

Faculty of Medicine, University of Montreal,

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Office Hours: Fridays 1:00-2:00 pm

Course Pre-requisites, Co-requisites, and/or Other Restrictions

Prerequisites: None

Students in life sciences, biomedical engineering, mechanical engineering, chemical engineering, materials engineering, chemistry, physics could take this course.

Course description

The purpose of this course is to introduce students to the emerging field of organ-on-a-chip engineering. Graduate and final year undergraduate students could take this course. It is also available for the students from other universities through the bureau de collaboration interuniversitaire (BCI). Using the current drug screening and safety testing paradigm, it takes approximately 15 years and cost over \$2 billion before a single compound may reach patients. Even so, late-stage drug attritions are still frequent. Animal and 2D in vitro models which are currently used in the pre-clinical stage of drug development are unable to mimic human physiology and pathophysiology, and therefore cannot accurately predict the biology and mechanisms involved in human dysfunctions. Therefore, novel approaches are needed to make drug discovery affordable and effective. The motivation for developing accurate and predictive models is twofold: first, to study and discover new treatments for various pathologies which are leading in worldwide morbidity and mortality rates; and second, to screen for adverse drug

reactions on different organs, a primary risk in drug development. In addition to in vivo animal models, organ-on-a-chip 3D in vitro models have been recently proposed to mimic the physiological conditions of the healthy and diseased tissues. In this course, we describe current organ-on-a-chip platforms for in vitro modelling of healthy and pathological tissues as well as their pros and cons for drug screening and discovery applications. We will also discuss the commercialization path of this advanced platforms.

Preliminary course schedule (subject to changes)

Date	Time	Topic	Instructor
Jan. 12	2-4 pm	Overview of OOC technology	Houman Savoji
Jan. 19	2-4 pm	Heart-on-a-chip	Houman Savoji
Jan. 26	2-4 pm	Microvasculature-on-a-chip Artery-on-a-chip Thrombosis-on-a-chip	Houman Savoji
Feb. 2	2-4 pm	Lung-on-a-chip	Guest Lecture
09-Feb	2-4 pm	Liver-on-a-chip	Guest Lecture
16-Feb	2-4 pm	Skeletal muscle-on-a-chip	Houman Savoji
23-Feb	2-4 pm	Cancer-on-a-chip	Guest Lecture
02-Mar	-	Break	-
09-Mar	2-3 pm	Midterm	
	3-4 pm	Cancer-on-a-chip	Guest Lecture
16-Mar	2-3pm	Brain & Nerve-on-a-chip	Houman Savoji
	3-4 pm	Student presentations	
23-Mar	2-3 pm	Kidney-on-a-chip	Guest Lecture
	3-4 pm	Student presentations	
30-Mar	2-3 pm	Bladder-on-a-chip	Guest lecture
	3-4 pm	Student presentations	
06-Apr	2-3 pm	Skin-on-a-chip	Guest Lecture
	3-4 pm	Student presentations	
13-Apr	2-3 pm	Multi organ-on-a-chip	Houman Savoji
	3-4 pm	Commercialization path	Houman Savoji
20-Apr	2-4 pm	Final Exam	Houman Savoji

Learning objectives / outcomes

This course will focus on the latest advancements in the field of Organ-on-a-Chip Engineering. A 2-hr weekly lecture will include the demonstration of the applied platforms as well as the discussion of the most recent literature. Assignments in the form of reading materials relevant to the topic presented that week will be given and discussed in the subsequent class. Each student should write a research paper (5 pages) on one of the organ-on-a-chip technologies. Students will also present their proposed platforms in the class.

At the end of this course, each student will be able to:

- Define and understand organ-on-a-chip technology;
 - Define and understand pros and cons of organ-on-a-chip technology;
 - Define and understand different organ-on-a-chip devices;
 - List challenges for organ-on-a-chip platforms;
 - Describe the commercialization path for the organ-on-a-chip platforms.
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Reading materials

Latest reviews and research papers will be assigned prior to each lecture to be read in advance.

Homework and academic calendar

(Subjects, reading assignments, due dates, exam dates)

Marking policy

Midterm	20%
Research paper	25%
Final (Comprehensive)	40%
Presentation	15%

Course Policies

Class Participation

Students are expected to attend all class sessions as listed on the course calendar.

Late Work Policy

Be sure to pay close attention to deadlines. There will be no make up assignments or homeworks, or late work accepted without a serious and compelling reason and instructor approval.

Missed Assignments/Tests

If you have missed a test or if there are extenuating circumstances that prevent you from completing an assignment on-time you must email the instructor ASAP, preferably BEFORE the deadline and NO LATER than one week after the due date. Requests for extensions will be granted if there are legitimate medical or compassionate grounds

only. The official UdeM medical form must be submitted.

Academic Misconduct

The University of Montreal's Code of Behaviour on Academic Matters outlines the behaviours that constitute academic misconduct, the processes for addressing academic offences, and the penalties that may be imposed. You are expected to be familiar with the contents of this document. The instructor is required to report any instance of suspected academic dishonesty and plagiarism.

Accommodations

If you have a learning need requiring an accommodation the University of Montreal recommends that students immediately register at Accessibility Services. The University of Montreal supports accommodations of students with special learning needs, which may be associated with learning disabilities, mobility impairments, functional/fine motor disabilities, acquired brain injuries, blindness and low vision, chronic health conditions, addictions, deafness and hearing loss, psychiatric disabilities, communication disorders and/or temporary disabilities, such as fractures and severe sprains, recovery from an operation, serious infections or pregnancy complications.

Mental Wellness

It is not uncommon for university students to experience a range of health and mental health issues that may result in barriers to achieving their academic goals. The University of Montreal offers a wide range of services that may be of assistance.