

# **BMDE 508**

## **Introduction to Micro and Nanobioengineering**

### **Course Description**

This interdisciplinary course is intended for graduate students having either a biological/medical background or an engineering, physical sciences background. The students will learn a variety of micro- and nanotechnologies that are useful for bioengineering, and simultaneously learn how these technologies can be used in biology and medicine and how they can help advance nanobiomedicine. An important aspect of this course is to open channels of communication and understanding between the different communities and cultures. The course will comprise lectures and weekly presentations of topical publications by the students, and time permitting, a lab demonstration.

This class is a participatory class and is premised of students attending the class and the presentations of their peers.

### **Learning Outcomes**

- Know the vocabulary and approach of the complementary field (biology & medicine vs physical sciences & engineering).
- Be capable of communicating with colleagues in the complementary field
- Give examples of micro- and nanotechnologies in biology and medicine
- Develop skills to critically evaluate and appraise research papers in the field
- Evaluate advantages and limitations of micro- and nanoscale bioengineering in specific fields of biology and medicine today.
- Identify the “pull” for new technologies in biology and medicine, and/or identify the “push” of technology in science and engineering, and how to align these two concepts.
- Gain an appreciation of the work and challenges of the complementary field
- Be able to develop further as an interdisciplinary scientists/engineer/medical researcher and invent ‘disruptive’ new technologies that will transform the field.

### **Class Locations**

Weekly Schedule	Tuesday, 9:35 am – 11:25 am; Thursday 9:35 am – 10:25 am
Class Lectures	Duff Medical Building, 3775 Rue University, Room 321
Lab Demo	Genome Quebec and McGill Innovation Centre, 740 Dr. Penfield Ave, Room 6500

### **Contact Information**

Instructor	David Juncker
Email	<a href="mailto:david.juncker@mcgill.ca">david.juncker@mcgill.ca</a>
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Office	Genome Quebec and McGill Innovation Centre, 740 Dr. Penfield Ave, Room 6206

Teaching Assistant 1	Yonatan Morocz
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Teaching Assistant 2	Houda Shafique
Email	<a href="mailto:houda.shafique@mail.mcgill.ca">houda.shafique@mail.mcgill.ca</a>

### **Guest Lecturers**

Félix Lussier	<a href="mailto:felix.lussier@mcgill.ca">felix.lussier@mcgill.ca</a>
Thomas Gervais	<a href="mailto:thomas.gervais@polymtl.ca">thomas.gervais@polymtl.ca</a>
Chris Moraes	<a href="mailto:chris.moraes@mcgill.ca">chris.moraes@mcgill.ca</a>
Rob Sladek	<a href="mailto:rob.sladek@mcgill.ca">rob.sladek@mcgill.ca</a>
Aaron Morris	<a href="mailto:aharmorr@umich.edu">aharmorr@umich.edu</a>

## Schedule

In the following table, Guest lecturers are in green. Deadlines are in red. 📅 indicates a short quiz.

Topic	Thu Class (1 hr)	Lecturer	Tue Class (2 hr)	Presenters
Introduction, Molecular Biology and the Cell	31-Aug	David Juncker	5-Sep	Félix Lussier 📅
Microtechnology and 3D printing	7-Sep	David Juncker	12-Sep	(Student Presentations)
<b>Add/Drop Deadline – Sep. 12, 2023</b>				
Microfluidics 1: Mass Transport	14-Sep	Thomas Gervais 📅	19-Sep	(Student Presentations)
Soft lithography and surface functionalization	21-Sep	David Juncker 📅	26-Sep	(Student Presentations)
Microfluidics 2: Lab-on-Chip Devices	28-Sep	David Juncker	3-Oct	(Student Presentations)
Design assignment	5-Oct	Design assignment tutorial (TAs)	10-Oct	<i>Reading break</i>
Lab session and grant writing	12-Oct	Grant review exercise + <b>grant review</b>	17-Oct	Lab session (TAs) (2 hr) + <b>Assignment 1</b>
Micro-Tissue Engineering	19-Oct	Chris Moraes 📅	24-Oct	(Student Presentations)
Organ-on-a-Chip, Body-on-a-chip	26-Oct	David Juncker 📅	31-Oct	(Student Presentations)
Immunoengineering	2-Nov	Aaron Morris 📅	7-Nov	(Student Presentations) + <b>grant title and short paragraph</b>
Genomics	9-Nov	Rob Sladek 📅	14-Nov	(Student Presentations) + <b>1-page grant summary</b>
Biomarkers and Precision Medicine	16-Nov	David Juncker	21-Nov	(Student Presentation) + <b>Assignment 2</b>
Wearables	23-Nov	David Juncker	28-Nov	(Student Presentations)
Wrap-up	30-Nov	<i>Friday schedule, no class</i>	5-Dec	<b>Self-reflective essay</b>
<b>Final project – Dec. 7, 2023</b>				

## Deadlines

	Opens	Due
<b>Assignment 1</b>	Sep. 21	Oct. 17
<b>Grant review session</b>	Oct. 3	Oct. 12
<b>Tentative Grant Title and short paragraph</b>	-	Nov. 7
<b>Assignment 2</b>	Nov. 9	Nov. 21
<b>Tentative 1-page grant summary</b>	-	Nov. 14
<b>Self-reflective essay</b> <i>(typically in class)</i>	-	Dec. 5
<b>Final project</b>	-	Dec. 7

## Evaluation

Coursework	Weight
Presentation <ul style="list-style-type: none"> <li>Journal articles provided 1-2 weeks in advance, prepare a 20-minute presentation.</li> </ul>	20%
Individual Assignments <ul style="list-style-type: none"> <li>1 design assignment with calculation (quantitative) (15%)</li> <li>1 assignment with some simple calculations (10%)</li> </ul>	25%
Grant Proposal <ul style="list-style-type: none"> <li>Write a mini proposal for a grant application in teams of 3-4 (assigned by the instructor and TAs).               <ul style="list-style-type: none"> <li><i>Must include one quantitative analysis in support of proposal</i></li> </ul> </li> <li>Undergraduates may write a literature review on an interdisciplinary research area and retrace its development ~20 pages in teams of 3-4 (assigned by the instructor and TAs).</li> <li>Submit a 1-page summary outlining the grant proposal/literature review. Worth 5% if better graded than the final submission.</li> </ul>	40% (5%)
Grant Review Session <ul style="list-style-type: none"> <li>Review past grant submissions and offer a critique of their strengths and weaknesses.</li> </ul>	4%
Self-Reflective Essay <ul style="list-style-type: none"> <li>Write a self-reflective essay (~1 page) summarizing your experience in the course, what you learned, feedback and suggestions for improvement.</li> </ul>	1%
Quizzes <ul style="list-style-type: none"> <li>Short quizzes related to the lectures.</li> </ul>	4%

Participation & Presence <ul style="list-style-type: none"> <li>• Participation in class discussions</li> <li>• Posting questions to the online discussion forum regarding the papers to be presented (by Sunday night). For presenters, answering posted questions (by Monday night)</li> </ul>	6%
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## Presentation Timeline

- Tuesday – Receive journal articles 1-2 weeks ahead of presentation (except first class)
  - If no paper is received in time, please contact David Juncker and/or Houda Shafique and Yonatan Morocz
- Tuesday – Contact David Juncker or the guest lecturer for the week.
  - Schedule an appointment by email (for David, please cc Trang at [admin.bme@mcgill.ca](mailto:admin.bme@mcgill.ca) for scheduling) to review the presentation.
- Read the paper and relevant literature. Prepare a draft presentation.
- Friday – Meet to discuss the draft presentation with the lecturer.
- Tuesday – Present the journal article to the class (20 minutes plus 10 minutes for questions)
- During the week...
  - **NON-PRESENTERS**
    - Each non-presenting student will be assigned one of two journal articles to read over and post one question about it on MyCourses every week by Sunday night at the latest.
    - *Note: Presenters do not have to post questions for the week they are presenting.*
  - **PRESENTERS**
    - Review questions posted in the online forum and answer them (by Monday night at the latest).

## Evaluation of Presentation

The in-class presentations will be graded on a scale of **100** as follows:

- Understanding of the material and answering online and in class questions: **30**
- Quality and clarity of slides and presentation, engagement of the audience: **30**
- Synthesis complex data, providing context for the topic, quality of appraisal (*i.e.* is the manuscript sound and are the conclusions supported by the data) and discussion (requires extra reading): **30**
- Improvements/adjustments based on feedback by the instructor during Friday preparatory meeting and (if applicable) online questions: **10**

## Quizzes

After each lecture, you will need to complete a short quiz (2-5 quick questions) on myCourses related to the lecture material. The deadline for completing the quiz is always by the end of the same day of that lecture (11:59 pm). You will have a total of 11 quizzes. Quizzes before add/drop period will count as bonus (2 quizzes). From the remaining 9 quizzes, the one with the lowest grade will be dropped. So there is a total of 8 graded quizzes, each weighing ~0.4% of your grade (excluding the bonuses).