Toronto Metropolitan University

Department of Electrical, Computer, & Biomedical Engineering
Faculty of Engineering & Architectural Science

Course Outline (F2024)

BME703: Tissue Engineering

Instructor(s)	Dr. Owais Khan [Coordinator] Office: ENG328 Phone: (416) 979-5000 x 556096 Email: owaiskhan@torontomu.ca Office Hours:
Calendar Description	Tissue engineering approach for augmentation or replacement of compromised tissue function in nerve, microvessels, skin and cartilage. Integrative exploration of the use of three-dimensional polymeric scaffolds and drug delivery vehicles, and gene therapy and cellular engineering for functional repair of injured tissues.
Prerequisites	BLG 601 and BLG 701
Antirequisites	None
Corerequisites	None
Compulsory Text(s):	1. None
Reference Text(s):	1. Tissue Engineering, Bernhard. Palsson, Sangeeta N. Bhatia, Pearson Prentice Hall, New Jersey, 2004
Learning Objectives (Indicators)	At the end of this course, the successful student will be able to: 1. Demonstrates understanding of cellular and tissue organization in various organs and at different stages of developmental cycle; tissue-based and stem cell therapies; and strategies to design and re-program organ specific cell phenotypes. (**1c**) 2. Demonstrate knowledge of mathematical models including compartment and continuous models that describe cell growth, division, differentiation, and death; cell media reaction processes; and bioreactor design problems. (**1d**) 3. Evaluates sources of information, checks the feasibility of design based on the obtained results, and assesses the reliability of conclusions. (**2a**) 4. Constructs hypothesis or problem statement consistent with the information available and the constraints/parameters of the problem. (**3b**) 5. Applies mathematical and scientific principles to predict behavior of systems or processes. (**3a**) 6. Uses technical knowledge, design methodology, and appropriate design tools and related resources. (**4a**) 7. Analyze data to make decisions. (**5b**) 8. Assesses ethical risks and evaluates situations and actions in terms of the professional code of ethics for engineers. (**10a**)

	NOTE:*Numbers in parentheses refer to the graduate attributes required by the Canadian Engineering Accreditation Board (CEAB).*
Course Organization	3.0 hours of lecture per week for 13 weeks 1.5 hours of lab per week for 12 weeks 0.5 hours of tutorial per week for 12 weeks
Teaching Assistants	Lab Teaching Assistants: ========== Aayush Chakravartti (aayush.chakravartti@torontomu.ca) Dana Almasri (dmasri1@torontomu.ca) Tutorial Teaching Assistants: ========== Quentin Currier-Mortisugu (qcurriermoritsugu@torontomu.ca) Abdul Malek Aziz (abdulmalek.azouz@torontomu.ca).
Course Evaluation	**Theory** Midterm Exam — 30 % Final Exam — 40 % **Laboratory** Labs — 30 % TOTAL: — 100 % **Note:** In order for a student to pass a course, a minimum overall course mark of 50% must be obtained. In addition, for courses that have both **"Theory and Laboratory"** components, the student must pass the Laboratory and Theory portions separately by achieving a minimum of 50% in the combined Laboratory components and 50% in the combined Theory components. Please refer to the **"Course Evaluation"** section above for details on the Theory and Laboratory components (if applicable).
Examinations	Midterm exam in Week 7, two hours (covers Weeks 1-6) Final exam, during exam period, three hours (covers Weeks 1-13).
Other Evaluation Information	Important Notes: ========== Any late submission of laboratory report (without justifiable reasons and advanced notice to the instructor/TA) will result in a mark deduction as below: a. A zero mark will be awarded for handing in no lab report b. 10% deduction if submitted within 24 hours late c. 20% deduction per day past deadline
Teaching Methods	Email Policy ========== In accordance with the Policy on Student E-mail Accounts (Policy 157), Toronto Metropolitan University (TMU) requires that any electronic communication by students to TMU faculty or staff be sent from their official university email account.

	Teaching Methods ========== Please refer to BME 703 Tissue Engineering Laboratory Manual for additional details of each lab session. All lab reports must have the standard cover page, to be signed by the student prior to submission, which can be completed and printed from the Department website at: https://www.ecb.torontomu.ca/guides/Standard_Cover_Page_Assignments.pdf
Other Information	None

Course Content

Week	Hours	Chapters / Section	Topic, description
1	3	Notes	Introduction to Tissue Engineering
2	3	Chapter 1 Sections 1.1-1.3 and Notes	Cellular Therapies
3	3	Chapter 2 Sections 2.1-2.3 and Notes	Tissue Organization
4	3	Chapter 5 and Notes	Stem Cells
5	3	Chapter 3, 4 and Notes	Tissue Dynamics and Morphogenesis
6	3	Chapters 6,7 Sections 6.1-6.5, 7.1-7.4 and Notes	Cell Differentiation
7	3	Midterm	---------- MIDTERM EXAM----------
8	3	Chapters 6,7 Sections 6.1-	Cellular Fate Processes I

		6.5, 7.1-7.4 and Notes	
9	3	Chapters 6,7 Sections 6.1-6.5, 7.1-7.4 and Notes	Cellular Fate Process II
10	3	Chapter 10 and Notes	Cell and Tissue Culture
11	3	Chapter 13 and Notes	Scaling up for Ex-Vivo Cultivation
12	3	Notes	Ethics, IP and Regulatory Affairs
13	3	Notes	Review

Laboratory(L)/Tutorials(T)/Activity(A) Schedule

Week	L/T/A	Description
2	Tutorial 1	Tutorial 1
3	Lab 1 Modules	Lab Safety; Biosafety; Pipetting; Microscopy
4	Tutorial 2	Tutorial 2
5	Lab 2 Modules	Membranes
6	Tutorial 3	Tutorial 3

7	Lab 3 Modules	Cytoskeleton
8	Tutorial 4	Tutorial 4
9	Lab 4 Modules	Phagocytosis
10	Tutorial 5	Tutorial 5
11	Lab 5 Modules	Growth of Cells

University Policies & Important Information

Students are reminded that they are required to adhere to all relevant university policies found in their online course shell in D2L and/or on the Senate website

Refer to the Departmental FAQ page for furhter information on common questions.

Important Resources Available at Toronto Metropolitan University

- The Library provides research workshops and individual assistance. If the University is open, there is a Research Help desk on the second floor of the library, or students can use the Library's virtual research help service to speak with a librarian.
- Student Life and Learning Support offers group-based and individual help with writing, math, study skills, and transition support, as well as resources and checklists to support students as online learners.
- You can submit an Academic Consideration Request when an extenuating circumstance has occurred that has significantly impacted your ability to fulfill an academic requirement. You may always visit the Senate website and select the blue radio button on the top right hand side entitled: **Academic Consideration Request (ACR)** to submit this request.

  For Extenuating Circumstances, Policy 167: Academic Consideration allows for a once per semester ACR request without supporting documentation if the absence is less than 3 days in duration and is not for a final exam/final assessment. Absences more than 3 days in duration and those that involve a final exam/final assessment, require documentation. Students must notify their instructor once a request for academic consideration is submitted. See Senate Policy 167: Academic Consideration.
- If taking a remote course, familiarize yourself with the tools you will need to use for remote learning. The Remote Learning Guide for students includes guides to completing quizzes or exams in D2L Brightspace, with or without Respondus LockDown Browser and Monitor, using D2L Brightspace, joining online meetings or lectures, and collaborating with the Google Suite.
- Information on Copyright for Faculty and students.

Accessibility

- Similar to an accessibility statement, use this section to describe your commitment to making this course accessible to students with disabilities. Improving the accessibility of your course helps minimize the need for accommodation.
- Outline any technologies used in this course and any known accessibility features or barriers (if applicable).
- Describe how a student should contact you if they discover an accessibility barrier with any course materials or technologies.

Academic Accommodation Support

Academic Accommodation Support (AAS) is the university's disability services office. AAS works directly with incoming and returning students looking for help with their academic accommodations. AAS works with any student who requires academic accommodation regardless of program or course load.

- Learn more about Academic Accommodation Support.
- Learn how to register with AAS.

Academic Accommodations (for students with disabilities) and Academic Consideration (for students faced with extenuating circumstances that can include short-term health issues) are governed by two different university policies. Learn more about Academic Accommodations versus Academic Consideration and how to access each.

Wellbeing Support

At Toronto Metropolitan University, we recognize that things can come up throughout the term that may interfere with a student's ability to succeed in their coursework. These circumstances are outside of one's control and can have a serious impact on physical and mental well-being. Seeking help can be a challenge, especially in those times of crisis.

If you are experiencing a mental health crisis, please call 911 and go to the nearest hospital emergency room. You can also access these outside resources at anytime:

- **Distress Line:**24/7 line for if you are in crisis, feeling suicidal or in need of emotional support (phone: 416-408-4357)
- **Good2Talk:**24/7-hour line for postsecondary students (phone: 1-866-925-5454)
- **Keep.meSAFE:** 24/7 access to confidential support through counsellors via My SSP app or 1-844-451-9700

If non-crisis support is needed, you can access these campus resources:

- **Centre for Student Development and Counselling:** 416-979-5195 or email csdc@torontomu.ca
- **Consent Comes First - Office of Sexual Violence Support and Education:** 416-919-5000 ext 3596 or email osvse@torontomu.ca
- **Medical Centre:** call (416) 979-5070 to book an appointment

We encourage all Toronto Metropolitan University community members to access available resources to ensure support is reachable. You can find more resources available through the Toronto Metropolitan University Mental Health and Wellbeing website.