

BME1001H1 S

Essential Biological and Chemical Lab Techniques for BME Winter 2027 Syllabus

Course Meetings

BME440H1 F

Section	Day & Time	Delivery Mode & Location
LEC0101	Tuesday, 12:00 PM - 3:00 PM	In Person: MB 325

Refer to ACORN for the most up-to-date information about the location of the course meetings.

The first class starts Tuesday January 12th.

Course Contacts

Instructors: Prof. Aereas Aung, Prof. Lindsey Fiddes, Prof. Omar Khan

Email: ae.aung@utoronto.ca, lindsey.fiddes@utoronto.ca, dr.khan@utoronto.ca

Office Hours and Location: TBA

Additional Notes: Please email me from your @mail.utoronto.ca email address and include the course code in the subject of your email.

Course Overview

Sound biological and chemical laboratory techniques are essential for experimentalists to obtain reliable and reproducible data. This course introduces fundamental laboratory practices, including aseptic technique, proper pipetting, and other core experimental skills. Building on these foundations, students will learn and apply advanced experimental techniques commonly used in biomedical engineering, including enzyme-linked immunosorbent assays (ELISA), flow cytometry, immunostaining, widefield microscopy, bioconjugation, and polymerization reactions. Through hands-on laboratory experience, students will develop practical proficiency with these methods and gain insight into experimental design and practices that improve data quality and accuracy.

Course Learning Outcomes

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

1. Apply aseptic technique and precise pipetting to perform basic mammalian cell culture procedures.
2. Design and execute ELISA-based immunoassays to quantify soluble biomolecules in biological samples.
3. Perform and interpret flow cytometry experiments to analyze cellular populations and phenotypes.

4. Measure gene expression in mammalian cells using RT-PCR and interpret resulting data.
5. Acquire and interpret biological images using widefield microscopy.
6. Perform immunostaining of cells and tissues to visualize specific molecular targets
7. Process and quantitatively analyze microscopy data using open-source software such as ImageJ.
8. Apply common chemical synthesis techniques, including bioconjugation, substitution reactions, and polymerization, to generate new biomaterials and molecular constructs.
9. Analyze and interpret experimental outcomes using complementary analytical methods (e.g., NMR) to determine the structure and properties of synthesized molecules.

Credit Value: 0.5

Course Materials

See Quercus.

Marking Scheme

Assessment	Percent	Details	Due Date
Pre-lab assignments	30%	Students will complete 12 pre-lab assignments prior to each laboratory session. These assignments require students to investigate the roles of reagents and the underlying concepts behind the experimental protocols before the in-class practical components.	Due weekly at the beginning of class.
Technical execution	35%	Students will be graded on their technical proficiency in executing the assigned experiments. Evaluation will include proper use of laboratory equipment, adherence to experimental protocols, data quality, and the reproducibility of results. During laboratory sessions, students will report experimental values obtained in class to demonstrate	Ongoing, see Quercus

		that their results are consistent with expected outcomes.	
Post-lab assignments	35%	Students will complete 12 post-lab assignments following each laboratory session. These assignments will involve analyzing and presenting experimental data in graphical form, performing basic statistical analyses, and discussing the overall outcomes of the experiments.	Ongoing, see Quercus

Mark revisions: There is a maximum one-week period after a quiz, lab-report, or term test is returned to you to query re-mark or revision. All grades will be posted to Quercus as soon as deliverables have been returned to the class. Students have until the last day of class (April 13th) to check the accuracy of the scores posted to Quercus. After this date, requests for revisions must be made through the Registrar's Office.

Academic integrity is of utmost importance. Any issues of plagiarism and/or inappropriate collaboration will be taken seriously and reported to the higher authority.

Late Assessment Submissions Policy

Submission deadlines are concrete. Late submissions will have a 5% late penalty per day. This is relevant for all lab deliverables.

Course Schedule

Week	Description
Week 1	Cell culture techniques, Part 1 • Overview of teaching laboratory health and safety procedures and protocols • Discussion of the function of biosafety cabinets and how they maintain sterility • Understanding the role of mammalian cell culture media components • Demonstration of aseptic techniques for mammalian cell culture • Hands-on thawing and seeding of cryopreserved cells
Week 2	Cell culture techniques, Part 2 • Understanding and performing trypsinization of adherent cells • Learning methods for cell counting, including use of a hemocytometer • Accurate aliquoting and dilution of cells • Cryopreservation of cultured cells
Week 3	Enzyme-linked immunosorbent assays (ELISAs)

	• Detection of analytes using indirect ELISA for signal amplification • Practice of pipetting techniques, serial dilutions, and multichannel pipette usage • Performing an indirect ELISA protocol • Analysis of results using a microplate reader
Week 4	Flow cytometry • Introduction to the concepts and workflow of flow cytometry • Understanding and performing staining with viability dyes and antibodies for surface markers • Quantification of cell populations using counting beads • Analysis of flow cytometry data
Week 5	Sample preparation and imaging: Cells, Part 1 • Understanding preparation of cultured cells for immunostaining analysis • Performing fixation, permeabilization, and immunostaining of cells • Implementing sample mounting procedures for microscopy
Week 6	Sample preparation and imaging: Cells, Part 2 • Understanding and performing fluorescence imaging using a widefield microscope • Processing and analysis of acquired images using ImageJ. Workflow includes image smoothing and background subtraction followed by morphological analyses such as cell orientation, confluency, area, and staining intensity
Week 7	Winter study break (no classes)
Week 8	Sample preparation and imaging: Tissues, Part 1 • Understanding tissue fixation and sucrose incubation procedures • Performing paraffin embedding and microtome sectioning protocols • Performing H&E staining of tissue sections for histological analysis
Week 9	Sample preparation and imaging: Tissues, Part 2 • Brightfield imaging of H&E-stained tissue sections • Performing and understanding microscope alignment for Köhler illumination • Understanding image acquisition settings, including color management • Whole-slide imaging • Image analysis
Week 10	Bioconjugation • New biomaterials can be produced through combination, which allows you to combine useful properties into one product

	Perform an coupling reaction (EDC) to link to biomolecules together
Week 11	Substitution reactions - Understand how to perform a common chemical reaction to make new materials - Use click chemistry to make new molecules
Week 12	Polymerization - Understand how polymer properties are influenced by the length of the resulting molecules, as well as the choice of the monomers - Perform a polymerization reaction
Week 13	Analytical methods Analyze a sample with orthogonal methods (NMR, mass spec and IR) to understand what information each gives and how you can use complementary analyses to understand what you made

Policies & Statements

University Land Acknowledgement

I wish to acknowledge this land on which the University of Toronto operates. For thousands of years, it has been the traditional land of the Huron-Wendat, the Seneca, and the Mississaugas of the Credit. Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.

Learn more about Canada's relationship with Indigenous Peoples [here](#).

Indigenous Students' Supports

If you are an Indigenous engineering student, you are invited to join a private Discord channel to meet other Indigenous students, professors, and staff, chat about scholarships, awards, work opportunities, Indigenous-related events, and receive mentorship. Email [Professor Bazylak](#) if you are interested.

Indigenous students at U of T are also invited to visit Nations House's (FNH) Indigenous Student Services for culturally relevant programs and services. If you want more information on how to apply for Indigenous specific funding opportunities, cultural programs, traditional medicines, academic support, monthly social events or receive the weekly newsletter, go to the FNH [website](#), [email](#) or follow FNH on social media: [Facebook](#), [Instagram](#), or [TikTok](#). A full event calendar is on the CLNX platform. Check CLNX often to see what new events are added!

Wellness and Mental Health Support

Your personal wellness and mental health are important. The University of Toronto and the Faculty of Applied Science & Engineering offer a wide range of free and confidential services that can support your well-being.

As a U of T Engineering student, you have a Departmental [Undergraduate Advisor](#) or a Departmental [Graduate Administrator](#) who can support you by advising on personal matters that impact your academics. Other resources that you may find helpful are listed on the [U of T Engineering Mental Health & Wellness webpage](#), and a small selection are also included here:

- [U of T Engineering's Student & Community Wellness Coordinator](#)
- [Health & Wellness](#) and the [On-Location Engineering Wellness Counsellor](#)
- [Health & Wellness Peer Support Program](#)
- [Accessibility Services](#) & the [On-Location Advisor](#)
- [Graduate Engineering Council of Students' Mental Wellness Commission](#)
- [SKULE™ Mental Wellness](#)
- [U of T Engineering's Learning Strategist](#) and [Centre for Learning Strategy Support](#)
- [Registrar's Office](#) and [Scholarships & Financial Aid Office & Advisor](#)

We encourage you to access these resources as soon as you feel you need support; no issue is too small. You may reach out to the counsellors at [U of T Telus Health Student Support](#) for 24/7 free and confidential counselling support.

If you find yourself feeling distressed and in need of more immediate support visit uoft.me/feelingdistressed or U of T Engineering's [Urgent Support – Talk to Someone Right Now](#).

Accommodations

The University of Toronto supports accommodations for students with diverse learning needs, which may be associated with mental health conditions, learning disabilities, autism spectrum, ADHD, mobility impairments, functional/fine motor impairments, concussion or head injury, visual impairments, chronic health conditions, addictions, D/deaf, deafened or hard of hearing, communication disorders and/or temporary disabilities, such as fractures and severe sprains, or recovery from an operation.

If you have a learning need requiring an accommodation the University of Toronto recommends that students [register with Accessibility Services](#) as soon as possible.

We know that many students may be hesitant to reach out to Accessibility Services for accommodations. The process of accommodation is private; we will not share details of your needs or condition with any instructor.

If you feel hesitant to register with us, we encourage you to reach out for further information and resources on how we can support. It may feel difficult to ask for help, but it can make all the difference during your time here.

Phone: 416-978-8060

Email: accessibility.services@utoronto.ca

Equity, Diversity and Inclusion

Looking for community? Feeling isolated? Not being understood or heard?

You are not alone. You can talk to anyone in the Faculty that you feel comfortable approaching, anytime – professors, instructors, teaching assistants, [first-year](#) or [upper years](#) academic advisors, student leaders or the [Assistant Dean of Diversity, Inclusion and Professionalism](#).

You belong here. In this class, the participation and perspectives of everyone is invited and encouraged. The broad range of identities and the intersections of those identities are valued and create an inclusive team environment that will help you achieve academic success. You can read the evidence for this approach [here](#).

You have rights. The [University Code of Student Conduct](#) and the [Ontario Human Rights Code](#) protect you against all forms of harassment or discrimination, including but not limited to acts of racism, sexism, Islamophobia, antisemitism, homophobia, transphobia, ableism, classism and ageism. Engineering denounces unprofessionalism or intolerance in language, actions or interactions, in person or online, on- or off-campus. Engineering takes these concerns extremely seriously and you can confidentially disclose directly to the Assistant Dean for help [here](#).

Resource List:

- [Engineering Equity, Diversity & Inclusion Groups, Initiatives & Student Resources](#)
- [Engineering Positive Space Resources](#)
- Request a religious-based accommodation [here](#)
- Email Marisa Sterling, P.Eng, the Assistant Dean, Diversity, Inclusion & Professionalism [here](#)
- Make a confidential disclosure of harassment, discrimination or unprofessionalism [here](#) or email engineering@utoronto.ca or call 416.946.3986
- Email the Engineering Society Equity & Inclusivity Director [here](#)
- [U of T Equity Offices & First Nations House Resources](#)

Academic Integrity

All students, faculty and staff are expected to follow the University's guidelines and policies on academic integrity. For students, this means following the standards of academic honesty when writing assignments, collaborating with fellow students, and writing tests and exams. Ensure that the work you submit for grading represents your own honest efforts. Plagiarism—representing someone else's work as your own or submitting work that you have previously submitted for marks in another class or program—is a serious offence that can result in sanctions. Speak to me or your TA for advice on anything that you find unclear. To learn more about how to cite and use source material appropriately and for other writing support, see the [U of T writing support website](#). Consult the [Code of Behaviour on Academic Matters](#) for a

complete outline of the University's policy and expectations. For more information, please see the [U of T Academic Integrity website](#).

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Quercus Information

This course uses the University's learning management system, Quercus, to post information about the course. This includes posting readings and other materials required to complete class activities and course assignments, as well as sharing important announcements and updates. The site is dynamic and new information and resources will be posted regularly as we move through the term, so please make it a habit to log in to the site on a regular, even daily, basis. To access the course website, go to the U of T Quercus log-in page at <https://q.utoronto.ca>. Once you have logged in to Quercus using your UTORid and password, you should see the link or "card" for this course. You may need to scroll through other cards to find this. Click on this link to open our course area, view the latest announcements and access your course resources. There are Quercus help guides for students that you can access by clicking on the "?" icon in the left side column.

SPECIAL NOTE ABOUT GRADES POSTED ONLINE: Please also note that any grades posted are for your information only, so you can view and track your progress through the course. No grades are considered official, including any posted in Quercus at any point in the term, until they have been formally approved and posted on ACORN at the end of the course. Please contact me as soon as possible if you think there is an error in any grade posted on Quercus.

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