

BME1420H1 F

Industrial Synthesis of Biological Macromolecules

Fall 2026 Syllabus

Course Meetings

BME440H1 F

Section	Day & Time	Delivery Mode & Location
LEC0101	Monday, 1:00 PM - 3:00 PM	In Person: UC 152
TUT0101	Monday, 3:00 PM - 4:00 PM	In Person: UC 85

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

Course Contacts

Instructor: Prof. Lindsey Fiddes

Email: lindsey.fiddes@utoronto.ca

Office Hours and Location: Tuesday 13:00 - 15:00 in MB 330

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

Biological macromolecules act as the pillars to sustain life. They provide cell structure, energy, aid in transport, store and transfer information, and send signals. They are high value goods that are manufactured to meet the demands of the industry (complexity, functionality, and purity). For example, the insulin protein is produced by recombinant DNA technology and has an annual market value of over \$20B USD; PCR primers can be delivered overnight by parallel automation of the synthesis to perform such logistical feats; and changing the molecular weight of hyaluronic acid gives it such versatility in the worlds of cosmetics and pharmaceuticals.

This course explores industrial practices for the synthesis of nucleic acids, proteins and polysaccharides. Students will examine the transition from fundamental organic chemistry to automated high-throughput synthesis, alongside the characterization tools required to verify molecular identity and purity. The choice of reactor to optimize molecular complexity, functionality, and purity will be examined. Emphasis will be put on macromolecules used in a lab setting.

Course Learning Outcomes

Upon completion of this course, you will:

- Understand solid-phase peptide synthesis (SPPS) versus biological production of polypeptides

- Understand solid-phase synthesis for the phosphoramidite synthesis of polynucleotides
- Understand extraction techniques and post-modification of industrial relevant polysaccharides
- Evaluate modern purification and characterization techniques (HPLC, Mass Spectrometry).
- Discuss emerging trends in biomaterials and biocompatibility

Credit Value: 0.5

Course Materials

See Quercus.

Marking Scheme

Assessment	Percent	Details	Due Date
Quizzes	20%	Ten quizzes given at the beginning of class weeks 2 – 11.	ongoing
Literature Presentation	20%	During tutorial sessions each student will present an article relevant to the current topic of the week. Presentations will be peer evaluated.	ongoing
Term test	30%	An in-class term test consisting of short answer and long answer questions. Test will be open book and completed either on paper or on device.	November 3, 2026
Strategic Optimization Report	30%	This assignment will be due at the end of term. The report will be 2 pages in length (not including figures and references) and distill the background knowledge learnt in the course and to propose new ways to achieve efficiency or cost effectiveness in the production of a biological macromolecule.	Dec 8, 2026

Mark revisions for the mid-term: 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 date of the

final exam 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	Nucleic Acid Chemistry - Structure of DNA/RNA; Protecting groups (DMT, cyanoethyl).
Week 2	Primer & Oligo Synthesis - The 4-step cycle: deprotection, coupling, capping, and oxidation.
Week 3	Enzymatic DNA Synthesis - PCR primer design, Gibson Assembly, in vitro transcription (IVT) and TdT-mediated synthesis.
Week 4	Peptide Synthesis I - Fmoc/t-Boc chemistry; Amino acid activation and coupling reagents. Native Chemical Ligation (NCL) for large protein synthesis.
Week 5	Antibodies – Polyclonal, monoclonal, and recombinant antibody production.
Week 6	Post-Translational Modification - Synthetic strategies for glycosylation, phosphorylation, and lipidation.
Week 7	Term test
Week 8	Characterization & Quality - Mass Spectrometry (ESI/MALDI) and analytical HPLC of polymers.
Week 9	Polysaccharides - Extraction and post-modification of polysaccharides.
Week 10	Biocompatibility and Bioconjugation - Click chemistry and cross-linking macromolecules to fluorophores.

Week 11	Phospholipids - Synthesis of industrial relevant lipid molecules.
Week 12	Nanomaterial Interfaces - Synthesizing DNA-coated nanoparticles and lipid-based carriers.

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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