The University of Western Ontario
Faculty of Engineering
Department of Chemical and Biochemical Engineering

CBE 3316B Sustainable Chemical Engineering and Life Cycle Analysis
Course Outline – Winter 2026

Course Summary

This course provides an introduction to sustainable chemical engineering and Life Cycle Analysis (LCA). Students will be introduced to approaches to evaluate the environmental impacts of technologies and processes and will apply these to different aspects of the economy, such as food production, transportation, waste management and energy production. This course will also focus on how to apply green engineering concepts to process design and evaluation in order to reduce energy consumption, waste/pollution production, and resource consumption in chemical engineering processes.

Prerequisite: CBE 2224B, CBE2220A

Corequisites/Anti-requisites: None

Classes	Lectures: M 2:30 - 4:30	SEB 3109
	F 9:30 - 10:30	SEB 3109
	Tutorial: W 3:30 – 4:30	SEB 3109

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Course Content:

I. Introduction to sustainability
- Carbon footprint assessment
- Water footprint assessment
- Material Flows
- Evaluating environmental fate of chemicals

II. Life Cycle Assessment
- Goal definition and scope
- Inventory analysis
- Material and energy flow analysis
- Life cycle impact assessment

III. Incorporating sustainability into chemical engineering processes
- Unit operations and pollution prevention
- Green chemistry and engineering
- Circular economy

IV. Social Life Cycle Assessment

Learning Outcomes

Students successfully completing this course will be able to:
- Identify sustainability challenges facing society in areas related to chemical engineering such as energy production, materials/resource extraction, food production and waste management
- Analyze how flows of materials, energy, and water affect the sustainability of a process
- Describe the concept of life cycle analysis as a method for assessing impacts of products or technologies
- Evaluate the impact of a process/product on the environment, for example by quantifying emissions, waste production, and energy consumption
- Compare the impacts of alternative processes or products
- Design processes using green engineering principles
- Understand ethical considerations in chemical engineering processes

Course Notes

Most of the course notes (not all) will be available for download from the course website. However, solutions to the problems and some of the materials used for discussions in class will not be posted on the course site. It is expected that notes on these materials will be recorded by the students during the lecture.

Evaluation

The final mark breakdown will be as follows:

Test 1:	20%
Test 2:	20%
Project:	25%
Final Exam:	35%

* Self reported absences may not be applied to Test 2.

Test 1 will be around week 5 of the term, Test 2 will be around week 11, and the final exam will be during the examination period. The project will have deliverables throughout the term.

Note: If a student misses a test exam due to illness or compassionate reasons, appropriate documentation must be provided and procedures described below must be followed. The weight of the test will be transferred to the final exam.

Important Note on Course Format

Students registered for this course are expected to attend all classes and tutorials, and are required to be present to complete all tests and exams in person. Any absence from an exam or test (without an appropriate letter of excuse through Undergraduate Student Services) will result in a grade of 0.

Text Book

Students are not required to purchase a text book for this class. However, the following books cover some of the material discussed in class, and may be helpful references:

1. Sustainable Engineering: Principles and Practice. Bhavik R. Bakshi, Cambridge University Press, 2019.
2. Sustainable Engineering: Concepts, Design, and Case Studies. David T. Allen, David R. Shonnard, Pearson Education Inc., 2012.
3. Sustainable Development in Practice: Case Studies for Engineers and Scientists, Second Edition. Edited by Adisa Azapagic and Slobodan Perdan, Wiley-Blackwell, 2011.

Graduate Attribute Assessment for Accreditation by the Canadian Engineering Accreditation Board

Graduate Attribute	Indicator	Assessment tool	Assessment Level
Impact of Engineering on Society and the Environment	IE1 Ability to analyze the interactions of engineering with economic, social, health, safety, legal and cultural aspects of society.	Effectively evaluate impacts of a process using life cycle assessment principles	D: Developed
Impact of Engineering on Society and the Environment	IE2 – Demonstrate understanding of the concept of sustainable design and development.	Identify approaches to evaluate or improve sustainability of chemical engineering processes	D: Developed
Ethics and Equity	EE 2 – Application of ethical behaviour.	Identify ethical dilemmas associated with a case study of a chemical engineering problem	D: Developed
Ethics and Equity	EE 4 –Awareness of the principles of equity	Students are able to identify ethical considerations in relation to a specific technology/process	D: Developed

CEAB Academic Units: Engineering Science 100%

Notice
Students are responsible for regularly checking their Western email and notices posted on the OWL course site.

Consultation
Individual consultation with the instructor can be arranged by appointment.

Email policy
Students wishing to communicate with the instructor by email should communicate through the OWL site. Students should allow a minimum of 2 business days to get a reply.

Missed/Late Accommodation Policy

1. Students missing an assignment or examination will need to report the absence by submitting Academic Consideration Request form through STUDENT ABSENCE PORTAL.
2. **Documentation must be provided as soon as possible.**

Exam Accommodation

1. If you are unable to write a final examination, report your absence using the Academic Consideration Request Form through STUDENT ABSENCE PORTAL.
2. Be prepared to provide the Undergraduate Services Office with supporting documentation the next day, or as soon as possible (in cases where students are hospitalized). The following circumstances are not considered grounds for missing a final examination or requesting special examinations: common cold, headache, sleeping in, misreading timetable and travel arrangements.
3. In order to receive permission to write a Special Examination, you must obtain the approval of the Chair of the Department and the Associate Dean and in order to apply you must submit an the Academic Consideration Request Form through STUDENT ABSENCE PORTAL.
   PLEASE NOTE: It is the student's responsibility to check the date, time and location of the Special Examination.

Late Assignments

1. Advise the instructor if you are having problems completing the assignment on time (prior to the due date of the assignment).
2. Be prepared to submit the Academic Consideration Request Form and provide documentation if requested by the instructor.
3. If you are granted an extension, establish a due date. The approval of the Chair of your Department (or the Assistant Dean, First Year Studies, if you are in first year) is not required if assignments will be completed prior to the last day of classes.

Medical Accommodation

1. Requests for Academic Consideration Request Form through STUDENT ABSENCE PORTAL.

2. Requests for academic consideration must include the following components:
    a. Self-attestation signed by the student (*This is only accepted for one absence, and may not be used for Test 2*)
    b. Medical note
    c. Indication of the course(s) and assessment(s) affected by the request
    d. Supporting documentation as relevant
3. Requests without supporting documentation are limited to one per term per course.
4. **Students must request academic consideration as soon as possible and no later than 48 hours after the missed assessment.**

Once the request and supporting documents have been received and reviewed, appropriate academic consideration, if granted, shall be determined by the instructor in consultation with the academic advisor, in a manner consistent with the course outline.

Religious Accommodation

When scheduling unavoidably conflicts with religious holidays, which (a) require an absence from the University or (b) prohibit or require certain activities (i.e., activities that would make it impossible for the student to satisfy the academic requirements scheduled on the day(s) involved), no student will be penalized for absence because of religious reasons, and alternative means will be sought for satisfying the academic requirements involved. It is the responsibility of such students to inform themselves concerning the work done in classes from which they are absent and to take appropriate action.

Academic Integrity

In the Faculty of Engineering, we encourage students to create a culture of honesty, trust, fairness, respect, responsibility, and courage, befitting the professional degree you are pursuing.

Please visit Academic Integrity Western Engineering for more information

Academic Offences

Plagiarism means using another's work without giving credit. The university has rules against plagiarism and other scholastic offences. Western Engineering has a zero-tolerance policy on plagiarism. The minimum penalty is zero on the course work and a repeat offence will earn you zero on the course. A third offence may lead to expulsion from the university.
Scholastic Discipline for Undergraduate Students & Cheating, Plagiarism and Unauthorized Collaboration: What Students Need to Know

Students must write their reports, essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning.

All required papers may be subject to submission for textual similarity review to commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted will be included as source documents on the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between the University of Western Ontario and Turnitin.com (http://www.turnitin.com). Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Handbook: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

Repeating All Components of the Course

In accordance with Senate and Faculty Policy, students who have failed an Engineering course (i.e. <50%) must repeat all components of the course. No special permissions will be granted enabling a student to retain assignment or test marks from previous years. Previously completed assignments cannot be resubmitted for grading by the student in subsequent years.

Use of English Policy

In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for improper use of English. Additionally, poorly written work except for the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

Accessibility

Western is committed to achieving barrier free accessibility for persons with disabilities studying, visiting and working at Western. As part of this commitment, there are a variety of services, groups and committees on campus devoted to promoting accessibility and to ensuring that individuals have equitable access to services and facilities. To help provide the best experience to all members of the campus community, please visit the Accessibility Western University for information on accessibility-related resources available at Western.

Students with disabilities may arrange for academic accommodation at Western. For a more detailed explanation, please visit Academic Support & Engagement -Academic Accommodation.

Inclusivity, Diversity, and Respect

The Faculty of Engineering at Western University is committed to creating equitable and inclusive learning environments that value diverse perspectives and experiences. We strive to facilitate equitable experiences and inclusion within the classroom by respecting and integrating multiple ways of knowing, being, and doing, and treating all students equitably regardless of Indigeneity, race, ethnicity, nationality, religion, ability, gender identity, gender expression, sexuality, age, language, and socioeconomic status. Please visit the Office of Equity, Diversity and Inclusion for additional information.

Students are expected to conduct themselves in a professional and respectful manner that is not disruptive to others, both in class and during course-related interactions outside the classroom.

Health and Well-Being

- Health & Wellness Services – Students - Offers appointment-based medical clinic for all registered part-time and full-time students.
- Mental Health Support - Provides professional and confidential services, free of charge, to students needing assistance to meet their personal, social and academic goals. Services include consultation, referral, groups and workshops, as well as brief, change-oriented psychotherapy.
- Crisis Support - For immediate assistant, please visit Thames Hall Room 2170 or call 519-661-3030. The crisis clinic operates between 11:00 am - 4:30 pm. For after-hours crisis support, click here.
- Gender-Based Violence and Survivor Support - Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced gender-based or sexual violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts, here. To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Important Contacts

Engineering Undergraduate Services	SEB 2097	519-661-2130	engugrad@uwo.ca
Civil & Environmental Engineering	SEB 3005	519-661-2139	civil@uwo.ca
Office of the Registrar/Student Central	WSSB 1120	519-661-2100	

Important Links

- WESTERN ACADEMIC CALENDAR
- ACADEMIC RIGHTS AND RESPONSIBILITIES
- ENGINEERING PROGRESSION REQUIREMENTS AND ACADEMIC REGULATIONS
- UNIVERSITY STUDENTS' COUNCIL (USC) - SERVICES
- IMPORTANT DATES AND DEADLINES
- ACADEMIC CONSIDERATION FOR MEDICAL ILLNESS - UNDERGRADUATE STUDENTS
- ACCOMMODATIONS FOR RELIGIOUS HOLIDAYS
- SCHEDULING OF ASSIGNMENTS, TESTS, AND EXAMINATIONS
- STUDENT FORMS
- OFFICE OF THE REGISTRAR
- RETENTION OF ELECTRONIC VERSION OF COURSE OUTLINES (SYLLABI)
- ACADEMIC APPEALS
- STUDENT ABSENCE PORTAL