CBE 4450A Chemical Engineering in Society
Course Outline 2026A

Description
Students will collaborate with industry and/or government partners to address complex open-ended engineering challenges framed using the United Nations Sustainable Development Goals (SDGs). Working in teams, students will formulate and refine a central inquiry question and investigate it through systems thinking, stakeholder analysis, and evaluation of multiple solution pathways.

The course emphasizes the interconnected nature of the **food-water-energy nexus** and requires students to analyze engineering problems in terms of economic, environmental, social, health, safety, legal and cultural considerations. Through an inquiry-based and team-oriented approach, students will develop and defend sustainable engineering strategies grounded in environmental stewardship, ethical reasoning, and real-world constraints.

Course Weight: 0.50

Prerequisites
Enrolment in Year 4 of the CBE program or by permission of the Department and instructors.
Prerequisite(s): CBE 3307A/B, CBE 3316A/B.
Unless you have either the prerequisites for this course or written special permission from your Dean to enroll in it, you will be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees if you are dropped from a course for failing to have the necessary prerequisites.

Corequisites
None

Antirequisites
None

Contact Hours:
2 lecture hour (weekly), 2 tutorial hours (weekly).

Instructors:
Dr. Andrew Hrymak ahrymak@uwo.ca Main Instructor

Undergraduate Assistant
(TEB 477) Telephone: 519-661-2111 ext: 82131 email: cbeugrad@uwo.ca

Suggested Text None

Lecture Materials
None: **this is an experiential learning course** with materials distributed through the course website and through self-study**.**

Units
SI, FPS, and CGS units will be used.

Learning Outcomes
By the end of this course, students will be able to:

1. Formulate and justify a complex, open-ended engineering inquiry question aligned with SDGs and stakeholder needs
2. Analyze engineering problems using systems thinking, including interactions within the food–water–energy nexus
3. Evaluate multiple engineering solutions using economic, environmental, social, and ethical criteria
4. Conduct stakeholder analysis to assess how perspectives influence engineering decisions
5. Propose and defend a sustainable engineering strategy incorporating ethical reasoning and risk considerations
6. Communicate technical and societal aspects of engineering work to both technical and non-technical audiences
7. Reflect on and adapt their learning and problem-solving processes in response to uncertainty and feedback

Project Theme
The project theme will be based on the UN Water, Food and Energy Nexus (https://www.unwater.org/water-facts/water-food-and-energy) including the areas of, but not limited to: energy; water systems, waste and circularity, climate change management, carbon capture and footprint reduction, sustainable supply chains. Each team will identify a **Central Inquiry Question** aligned with one or more of the SDGs.

Inquiry Tools and Templates
Students will use structured analytical tools introduced and applied during tutorial sessions:

- Systems Mapping Worksheet (food–water–energy nexus, ripple effects)
- Stakeholder Analysis Worksheet (interests, influence, conflicts, engagement)
- Trade-Off Matrix (multi-criteria decision analysis of solutions)

These tools must be incorporated into milestone submissions and the final report.

Weekly Lecture/Tutorial

The lecture times will be used for the entire class to participate in a discussion of the weekly topics, as well as invited guest lectures. The tutorial times will be used for the individual teams to work on their project, make presentations related to their projects and discuss progress and questions with the instructor.

Attendance is mandatory – repeated absences without permission of the instructor will lead to a zero grade for Participation and Group Evaluation components of the Course Evaluation.

Course Plan: (topics may be rescheduled)

Each week's activities will be a mix of lectures, discussion and workshop format. Readings will be assigned and provided on the course website. Participation in the discussion is part of learning!

Note: Preliminary schedule subject to change – changes will be communicated as soon as known to the class via OWL Brightspace email. There are no classes on the week of October 12th due to Thanksgiving and Fall Break Week.

Weeks 1–3: Inquiry Framing

- Introduction to SDGs and nexus systems
- Team formation and partner engagement
- Workshop: strong vs. weak inquiry questions
- Development and refinement of Central Question

Milestone: Draft Central Question

Weeks 4–6: Systems and Stakeholders

- Stakeholder role-play and analysis workshop
- Systems mapping workshop (food–water–energy nexus)
- Ripple effects and unintended consequences

Milestone: Stakeholder Analysis + Systems Map

Weeks 7–9: Solution Development

- Identification of multiple solution pathways
- Trade-off matrix workshop
- Risk, uncertainty, and ethical considerations

Milestone: Solution Comparison Outline

Weeks 10–11: Decision-Making and Ethics

- Sustainability and environmental stewardship
- Ethical decision-making workshop
- "Defend your solution" structured debate

Weeks 12–13: Synthesis and Communication

- Writing for decision-makers (brief/report)
- Visual communication (systems maps, diagrams)
- Peer teaching design

- Final presentations and interactive symposium

Final Deliverables:

- Inquiry Report
- Presentation + Peer Teaching Activity
- Final Reflection

Evaluation

• Participation (in class, individual)	10%
• Reflections (individual)	15%
• Milestone Reports	
1. Central Question and Preliminary Literature Review (Written, team)	15%
2. Stakeholder Analysis (Written, team)	10%
3. Solution Comparison Outline (Written, team)	5%
• Final Reports	
○ Inquiry Report (Written, team)	20%
○ Final Reflection (Written, individual)	5%
○ Final Inquiry Report (Oral Presentation, team)	20%
Total	100%

- Late Reflections will not be accepted.
- Late Reports will be penalized at 10% per day.

Participation Rubric

Outstanding Contribution (9-10)

- Contributes at the highest levels and frequently to the discussions;
- Contributions reflect preparation and careful attention to the ongoing discussion;
- Contributions include strong follow-up comments and questions;
- Contributions integrate concepts with other subjects, explains difficult points or concepts;

Excellent Contribution (8)

- Contributes frequently to discussions;
- Contributions reflect preparation and careful attention to the ongoing discussion;
- Explains difficult points and concepts incorporating ideas from other subjects or courses;
- Helps guide class discussions;

Good Contribution (7)

- Contributes regularly to discussions;
- Contributions indicate consistent preparation and thoughtful responses to the ongoing discussion;
- Raises questions that help focus on difficult points or concepts;
- Contributes reasonable arguments for a position.

Fair Contribution (6)

- Contributes irregularly to class discussions;
- Gives occasional indications of preparation;

- Infrequently builds on the ongoing discussion.

Poor Contribution (5)

- Contributes rarely to discussions;
- Gives little indication of preparation and thought;
- Does not contribute to a positive atmosphere for meaningful discussion.

Unsatisfactory Contribution (0-4)

- Almost never contributes to discussions;
- Minimal indication of preparation or thought;
- Actively inhibits or impedes class discussions;
- Misses a significant number of class sessions.

Reports

Note: References and figures are not included in the word count.

Central Question and Preliminary Literature Review (Written, team)

Introduction and background (250-500 words), Development and justification of the CQ (250-500 words), Lines of inquiry pursued by each member of the team (250-500 words).

Stakeholder Analysis (Written, team) (500-100 words)

Solution Comparison Outline (Written, team) (500 – 1000 words)

Final Inquiry Report (Written, team)

Introduction and background, Development and justification of the CQ, Lines of inquiry pursued by each member of the team, Separate sections critically evaluating the evidence and arguments for each line of inquiry, Individual concluding sections for each line of inquiry, summary and conclusions. (4000 - 5000 words)

Reflections

A useful resource can be found at https://experience.uwo.ca/pdfs/faculty_resources_and_examples/Reflection%20Journal_UpdatedFooter.pdf

The reflection journals are personal documents capturing your individual journey in the discovery, learning, community engagement and team. The instructor will be the only person who has access and will provide feedback where appropriate. The content is up to you - experiences, learnings, feelings, connections, and how these affect your plans in the next steps. The reflections build on one another, and your plans may (likely will) change during the term. Students will maintain reflective journals throughout the course.

Reflections should address:

- Team dynamics and collaboration
- Learning progress and challenges
- Responses to uncertainty and feedback
- Evolution of the inquiry question and solution
- Integration of systems, stakeholder, and trade-off analyses

Notes:

- Attendance and active participation are required
- This is an **experiential, inquiry-based course**—progress depends on engagement
- Students are expected to work professionally with external partners
- All analytical tools and frameworks introduced in tutorials must be applied in submissions

Use of English
In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for the improper use of English. Additionally, poorly written work with the exception of the final examination (not applicable in this course) 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.

Attendance
Attendance in seminars and tutorials is mandatory for 4th year students enrolled in the course**. Any student who, in the opinion of the instructor, is absent too frequently from class or laboratory periods in any course, will be reported to the Dean (after due warning has been given).**

Cheating
University policy states that cheating 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 (see Scholastic Offence Policy in the Western Academic Calendar).

Statement on Academic Offenses
Students must write their team reports 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. Plagiarism is a major academic offence (see Scholastic Offence Policy in the Western Academic Calendar).
The University of Western Ontario has software for plagiarism checking. Students may be required to submit their work in electronic form for plagiarism checking.

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following website: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_offences.pdf.

All required reports may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All report submitted for such checking will be included as source documents in 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 Western University and Turnitin.com (http://www.turnitin.com).

Artificial Intelligence

Students are ultimately accountable for any work they submit for this course. The use of any AI tool must be documented with the submitted deliverable; the documentation must include which AI tool(s) were used, how they were used and how the results were incorporated into the submission. In addition, any content produced by AI tool must be cited appropriately.

Sickness and Other Problems
Students should immediately consult with the instructor or Department Chair if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented. The student should seek advice from the Instructor or Department Chair regarding how best to deal with the problem. Failure to notify the Instructor or Department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.

Notices
Students are responsible for regularly checking their Western email, the website of the course on OWL.

Support Services
The website for the Office of the Registrar (http://www.registrar.uwo.ca), and the same for affiliated university colleges when appropriate, and any appropriate Student Support Services (including the services provided by the USC listed here: http://westernusc.ca/services/) and Academic Support and Engagement.

Conduct
Students are expected to conduct themselves in a professional and respectful manner that is not disruptive to others.

Gender-Based and Sexual Violence
Western is committed to reducing incidents of gender-based and sexual violence (GBSV) and providing compassionate support to anyone who is going through or has gone through these traumatic events. If you are experiencing or have experienced GBSV (either recently or in the past), you will find information about support services for survivors, including emergency contacts at the following website:
https://www.uwo.ca/health/student_support/survivor_support/gethelp.html
To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Students who are in emotional/mental distress should refer to Mental Health@Western http://www.uwo.ca/uwocom/mentalhealth/ for a complete list of options about how to obtain help.

Accreditation (AU) Breakdown
Engineering Science 50%
Complementary Studies 50%
Graduate Attribute Assessment for Accreditation by the Canadian Engineering Accreditation Board

Learning Outcome	Assessment Method	CEAB Graduate Attribute	
Inquiry Question	Central Question Submission	Problem Analysis	
Systems Thinking	Systems Map	Impact of Engineering on Society & Environment (IESE)	IESE – 2 A
Solution Evaluation	Trade-Off Matrix	Investigation	
Stakeholder Analysis	Stakeholder Report	IESE	IESE – 3 A
Strategy Proposal	Final Inquiry Report	Design	EPM - 4 A
Communication	Presentation + Peer Teaching	Communication Skills	
Reflection	Reflection Journals	Lifelong Learning	

Embedded Assessment Rubric

1. Inquiry & Problem Framing
- **Excellent:** Complex, clearly justified, strongly aligned with SDGs and stakeholder needs
- **Good:** Clear and relevant question with reasonable justification
- **Satisfactory:** Basic or partially developed question
- **Needs Improvement:** Unclear, narrow, or poorly justified

2. Systems & Stakeholder Analysis
- **Excellent:** Demonstrates deep systems thinking; clear connections across the nexus; nuanced stakeholder understanding
- **Good:** Identifies major system components and stakeholders
- **Satisfactory:** Limited depth of analysis
- **Needs Improvement:** Minimal or inaccurate analysis

3. Evaluation & Recommendation
- **Excellent:** Strong comparison of multiple solutions; clear trade-offs; ethical reasoning evident
- **Good:** Logical recommendation with some supporting analysis
- **Satisfactory:** Limited comparison; weak justification
- **Needs Improvement:** Unsupported or unclear recommendation

4. Communication & Peer Teaching
- **Excellent:** Clear, engaging, audience-appropriate; highly interactive
- **Good:** Clear and organized; moderate engagement
- **Satisfactory:** Understandable but lacks clarity or engagement
- **Needs Improvement:** Unclear, disorganized, or ineffective

5. Reflection & Adaptation
- **Excellent:** Deep reflection; demonstrates learning, adaptation, and awareness of uncertainty
- **Good:** Thoughtful reflection with some insight
- **Satisfactory:** Descriptive but limited insight
- **Needs Improvement:** Minimal or incomplete reflection