The University of Western Ontario
Faculty of Engineering

DEPARTMENT OF CHEMICAL & BIOCHEMICAL ENGINEERING

CBE 4497/98 – Chemical Process and Plant Design
Course Outline 2025-2026

Course Description

A design is prepared for a full-scale chemical/biochemical process. It starts with a critical review of alternate processes and development of detailed flown plan by a team of students. Process synthesis with consideration of safety, environmental impact and energy efficiency is followed by equipment design and costing. Problem formulation, alternative design solutions and professional decision making are emphasized. Regulations, standards and codes related to design tasks are reviewed, bringing the students closer to real world engineering. Use of engineering tools and simulation of the process using available software packages are important part of the course. The final report includes sections on process safety and hazard analysis, environmental impact analysis and detailed process economics analysis.

Prerequisites: CBE 2220A/B, CBE 2224A/B, GPE 3315A/B, CBE 3322A/B, CBE 3323A/B, CBE 3324A/B, and CBE 3318A/B, CBE 3319 A/B.

Unless you have the requisites 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.

Corequisite(s): n/a

Antirequisite(s): CEE 4441, ECE 4416, MME 4499, SE 4450, ES 4499, MSE 4499, ECE 4415.

Contact Hours: 2 lecture hours, 3 tutorial hours, 1.0 course

Instructors:

- Anand Prakash (coordinator), Ph.D., P.Eng., TEB 441, email: aprakas2@uwo.ca t.: 519-661-2111 ex. 88528
- Mita Ray, Ph.D., P.Eng., TEB 443, email: mbhowmic@uwo.ca
- Katherine Albion, Ph.D., P.Eng., email: kalbion@sarnialambtonresearchpark.ca
- Cedric Briens, Ph.D., P.Eng., email: cbriens@uwo.ca
- Naomi Klinghoffer, email: nklingh@uwo.ca

Teaching Assistants:

- Joshua Cullen, email: jculle@uwo.ca
- Sara Muro Herrera, email: smuroher@uwo.ca
- Ehsan Khorshidi, email: ekhorshi@uwo.ca
- Bret Gregory, email: bgregor5@uwo.ca
- Salil Mathew, email: smathe63@uwo.ca

Undergraduate Assistant: Brandy Hunter
Office: TEB 477, Telephone: 519-661-2111 ext. 82131, email: brandy.hunter@uwo.ca

Recommended Text

Towler, G. and R. Sinnott "Chemical Engineering Design", Elsevier, Inc. 2012.
Turton R., R.C. Bailie, W.B. Whiting, J.A. Shaeiwitz D. Bhattacharyya," Analysis, Synthesis and Design of Chemical Processes", 2nd edition, Prentice Hall PTR, 2012.

Reference Texts

Jones, D.S.J., "Elements of Chemical Process Engineering", John Wiley and Sons, 1996.
Ludwig E.E., "Applied Process Design for Chemical and Petrochemical Plants", Vol. 1-3, 2nd and 3rd edition, Gulf Publishing Co., 1983, 1995.
Perry, R.H. and D.W. Green, "Perry's Chemical Engineers Handbook", 7th edition, McGraw-Hill Inc., 1997.
Soares, C., "Process Engineering Equipment Handbook", McGraw Hill, New York, 2002.
Ulrich, G.D., "A Guide to Chemical Engineering Process Design and Economics", John Wiley & Sons, New York, 1984.
Walas, S.M., "Chemical Process Equipment Selection and Design", Butterworth-Heinemann, 1990.

Reference to other books and articles will be made at the appropriate time during the course.

Course Notes

Condensed course notes, reports guidelines lectures slides will be available for download from the course website.

Units

The International System of Units (SI) will be used in this course.

General Learning Objectives

Based on case study format, this course introduces students to synthesis and analysis chemical, biochemical and pollution abatement processes and equipment selection and sizing through creative problem solving and teamwork while applying basic principles in chemical engineering and economics learned in other courses in the curriculum. The general objectives are for the student to become able to:

- apply engineering and professional judgement to propose solutions to open-ended design problems.
- formulate problems and apply decision making to evaluate design alternatives.

- identify safety, environmental, social, legal and economic issues, and their impact on design decisions.
- develop strong technical communication skills in order to present and defend technical information and design decisions in both written and oral format and recognize the need for continual (life-long) learning to keep abreast of new developments and information that could affect decisions related to design, modifications and improvements in chemical processes.

These objectives are accomplished within the framework of a workshop, simulating to the extent possible, and the real-world industrial environment. During the workshops, groups of up to six students are given guidance and coaching (interactive learning) to assist in moving forward the design project. Each group of project engineers is assigned to a specific section head (Teaching Assistant) and an advisor.

Specific Learning Objectives

The course is organized to develop following professional and job-related skills of students while **they apply acquired knowledge of engineering concepts and principles to a study of an industrial design project**.

Teamwork and Time Management

Students should be able to:

- work in a team as they become more familiar with dynamics of teamwork and learn to make use of strengths of team members.
- divide a project into tasks and sub-tasks with deadlines and milestones to allow scheduling and resource allocation and utilization.

Information Collection, Analysis and Synthesis

Students should be able to:

- collect required information from different sources including literature, industry, equipment suppliers, internet, specialists etc.
- analyse sometimes conflicting information and learn to deal with it.

Critical Thinking (applied to design process)

Students should be able to:

- recognize existence of alternative solutions for the same problem.
- compare alternatives based on selected criteria.
- ensure check calculations and consultations before making a recommendation.

Engineering Judgment

Students should be able to:

- apply approximations in design calculations based on sound reasoning and documentation.
- apply practical considerations to reduce downtime, improve safety and operability of a system being designed.

Engineering Safety & Environmental Protection

Students should be able to:

- incorporate engineering safety in their final design and modify the design accordingly
- perform HAZOP study for the designed units
- perform Layers of protection analysis (LOPA) for their design

- do risk assessment for the process
- perform environmental protection analysis addressing safety issues
- perform safety and risk analysis

Communication

Students should be able to:

- present their work both orally and in written format as per acceptable standards.
- participate in two formal group presentations to communicate progress.
- submit two large formal reports and three shorter progress reports.

Graduate Attribute Assessment for Accreditation by the Canadian Engineering Accreditation Board

Graduate Attribute	Indicator	Assessment tool	Assessment Level
Design (DE)	1) Demonstrate ability to frame a complex, open-ended design problem in engineering terms 2) Demonstrate ability to generate a diverse set of candidate engineering design solutions 3) Demonstrate ability to select candidate engineering design solutions for manufacturing pathway for further development. 4) Demonstrate ability to advance an engineering design to a defined end state while applying principles of safety and operability with applicable regulations.	Report 1: Project Defin.& Scope Report 2: PFD Report 3: Fall Progress Report Report 4 :Equipment Design and Costing	Applied
Individual and Teamwork (IT)	1) Demonstrates ability to contribute to team goals during a formal team presentation to communicate project progress. 2) Ability to evaluate peer and self performance. Can apply conflict management techniques to resolve team issues while putting together a final report consisting of several sections.	Assessments of Oral Presentations by invited judges Online Peer Evaluations	Applied
Communication Skills (CS)	1) Demonstrate ability to articulate ideas in writing using appropriate technical language, and effective graphical tools 2) Demonstrate the ability to communicate orally using appropriate materials, language, non-verbal communication, and effective graphical tools.	Report 5: Final Report Final Presentations (industry judges)	Applied
Economics and Project Management (EPM)	1) Demonstrate ability to apply economic considerations based on estimations of capital and operating costs and profitability analysis. 2) Demonstrate ability to manage time, and resources of a project as well methodically conduct risk assessment and reduction studies.	Report 5:Proces Economics Section of Final Report	Applied

Engineering Tools (ET)	Identify and apply appropriate set of engineering tools for a given task for high quality professional finish.	Report 2: PFD Report 5: Final Report	Applied
Life-long learning (LL)	Analyze sometimes conflicting information and develop strategies to manage and reconcile it effectively.	Report 5: Final Report	Applied

Progress will depend on a number of factors including complexity of the selected process, availability of process information, industrial contacts established by group, etc. Initiative and creativity are required from every student.

This course draws on knowledge, skills and techniques learned in prerequisite and corequisite courses to solve practical engineering problems.

Deliverables and Assessment

Report 1: Project Definition and Scope	8%
Report 2: Process Flow Plan and Description	12%
Report 3: Fall Term Report	15%
Report 4: Individual Design Report	15%
Report 5: Final Report	25%
Fall Progress Oral Presentation	8%
Final Oral Presentation	12%
Participation and Peer Evaluation	5%

Design Reports

Reports will be submitted electronically on the course OWL site. Requirements for content, formatting and due dates will be provided on the OWL site. The penalty for late submission of a report is 5% points per day.

Oral Presentations

Two oral presentations will be made by each design group, one in each term. Each student must participate in the presentations. Presentation schedule will be posted on course site approximately two weeks before presentations.

Contingency Plan for an in-Person Class Pivoting to 100% Online Learning

In the event of a COVID-19 resurgence during the course that necessitates the course delivery moving away from face-to-face interaction, all remaining course content will be delivered entirely online, either synchronously (i.e., at the times indicated in the timetable) or asynchronously (e.g., posted on OWL for students to view at their convenience). The grading scheme will not change. Any remaining assessments will also be conducted online at the discretion of the course instructor

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 laboratory, assignment or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted for grading by the student in subsequent years.

Use of English

In accordance with Senate and Faculty Policy, students may be penalised 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 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.

Policy Framework: Missed Classes, Late Work, and Academic Integrity

Absence/Late Accommodation Policy

1. Students must familiarize themselves with the University Policy on Academic Consideration –

   Undergraduate Students in First Entry Programs posted on the Academic Calendar: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/academic_consideration_Sep24.pdf

   This policy does not apply to requests for Academic Consideration submitted for attempted or completed work, whether online or in person. The policy also does not apply to students experiencing longer-term impacts on their academic responsibilities. These students should consult Accessible Education.

2. Students missing a test/assignment/lab or examination will report the absence by submitting Academic Consideration Request form through STUDENT ABSENCE PORTAL.

3. **All requests for Academic Considerations must be made within 48 hours after the assessment date or submission deadline. All Academic Consideration requests must include supporting documentation. However, recognizing that formal documentation may not be available in some extenuating circumstances, the policy allows students to make one Academic Consideration request without supporting documentation in this course. However, the following assessments are excluded from this, and therefore always require formal supporting documentation:**

   - **Examinations scheduled during official examination periods.**
   - **Midterm Tests and other designated assessments as noted on the course outline.**
   - **Any assessment already covered by a flexible deadline.**
   - **If a student mistakenly submits their one allowed Academic Consideration request without supporting documentation for the assessments listed above that do not require academic consideration, the request cannot be recalled and reapplied. This privilege is forfeited.**

4. **Requests without supporting documentation are limited to one per term per course.**

5. **An undocumented absence is only valid for a 24-hour period, from midnight on the day specified to midnight of the following day.** An appropriate use of an undocumented absence would be for an in-class assessment that takes place that day. Where the time given to

complete the assessment is longer than 24 hours, an undocumented absence will not cover a student for the full time given to complete the assessment, and flexibility considerations in submitting the assessment will override the undocumented absence.

7. NOTE: Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence.

8. It is the student's responsibility to check the date, time and location of the Special Examination.

II. 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. If a suitable arrangement cannot be worked out between the student and instructor involved, they should consult the appropriate Department Chair and, if necessary, the student's Dean.

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.

III. 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

IV. 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

V. Faculty of Engineering AI Policy

The use of generative Artificial intelligence (GenAI) tools won't be discouraged in the Faculty of Engineering. As we pride ourselves on building the future we can't hide from the use of GenAI tools to contribute to the understanding of the course materials. You are able to use GenAI tools as follows:

- For any written assignment, except take-home exams and personal reflections, you may use a GenAI tool to help you brainstorm or frame your initial ideas and grammar. However, your final submission must be entirely in your own words and demonstrate your individual experience and insight.
- For any written or practical project AI tools may be used across your workflow. Use them responsibly and reflect in your final presentation on how these tools supported or challenged your creative thinking.
- All GenAI tools used at any point of the course with the intent of helping with homework, assignments or any other assessment content must be disclosed and referenced appropriately.

GenAI tools use won't be permitted in any type of examination or other assessments where the faculty have prohibited their use. If use of GenAI tools is detected by the instructor in these instances, academic offences penalties might be imposed against the student.

VI. 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.

VII. 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 recognize that university courses often marginalize students based on social identity characteristics such as, but not limited to, Indigeneity, race, ethnicity, nationality, ability, gender identity, gender expression, sexuality, age, language, religion, and socioeconomic status. Understanding this, we strive to facilitate equitable experiences and inclusion within the classroom by respecting and integrating multiple ways of knowing, being, and doing. Please visit the Office of Equity, Diversity and Inclusion.

VIII. **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 (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.

Important Contacts

Engineering Undergraduate Services	SEB 2097	519-661-2130	engugrad@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

Attendance

Attendance at all lectures, tutorials and laboratories is mandatory. Any student who, in the opinion of the instructor, is absent too frequently from class, or workshop/tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from making final oral presentation and submission of final design report.

Conduct

Students are expected to arrive at lectures on time, and to conduct themselves during class in a professional and respectful manner that is not disruptive to others.

Notices

Students are responsible for regularly checking their Western email and notices posted in front of chief instructor's offices.

Consultation

Students are encouraged to discuss problems with their teaching assistant and/or instructor in tutorial sessions. Office hours will be arranged for the students to see the instructor and teaching assistants. Other individual consultation can be arranged by appointment with the appropriate instructor.

Accreditation (AU) Breakdown

Engineering Science	= 25%
Engineering Design	= 75%