Faculty of Engineering

CBE 4409B – Wastewater Treatment
Winter 2026

Description
This course introduces a basic understanding of municipal wastewater treatment processes. The course reviews pertinent environmental regulations, and general wastewater quality parameters. Processes and unit operations in wastewater treatment are introduced with particular emphasis on process design. Considerations in integrating unit processes and operations into a treatment system are presented.

Prerequisites
CBE 2290A/B or CEE 2217A/B or Chemistry 2210A/B.

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may 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 in the event that you are dropped from a course for failing to have the necessary prerequisites.

Corequisites
None

Antirequisites
The former CBE 3363A/B

Contact Hours
3 lecture hours (Tuesday, 8:30 am-11:30 am in SEB 2099), 1 tutorial hour (Thursday, 1:30-2:30 pm SEB HSB 9), 0.5 course.

Delivery Mode
In-person lectures and tutorials

Instructor
Dr. G. Nakhla (SEB 3037) Telephone: 519-661-2111 ext: 85470 email: gnakhla@uwo.ca.
Teaching assistant: Hossein Naeimi email: hnaeimi2@uwo.ca

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

Required Texts
Ronald L. Droste, "Theory and Practice of Water and Wastewater Treatment", John Wiley and Sons,1st ed., 1997/2nd ed., 2019.

Reference Texts
Metcalf and Eddy Inc., "Wastewater Engineering: Origins, Characteristics, Treatment", 4th or 5th edition, McGraw Hill, 2003 or 2014.

Course Notes
Uploaded on the course website

Units
Both SI and imperial units will be used.

General Learning Objectives

A knowledge base for engineering		**Individual and team work**		**Economics and project management**	.
Problem analysis	A	**Communication skills**		**Life-long learning**	
Investigation		**Professionalism**		**Key:** **I: evaluated at introductory level** **A: evaluated as application**	
Design		**Impact of engineering on society and the environment**	A		
Use of engineering tools		**Ethics and equity**			

The general objectives of the course are to enable students to :

- Develop treatment processes to meet various effluent objectives dictated by regulations
- Design various physical, chemical, and biological treatment processes and assess the impact of changes in process parameters on performance
- Evaluate different disinfection technologies and their impacts on receiving water bodies

Specific Learning Objectives

Unit 1 (Weeks 1-2): What is Water Pollution?

At the end of this topic, students should be able to gain:
• A fundamental understanding of water pollution.
• An understanding of discharge limits, for pollutants.
• An understanding of the environmental legislation.

Unit 2 (Weeks 2-3): Water Pollution Control

At the end of this topic, students should be able to:
• Describe basic concepts involved in water pollution control.
• understand the function of various wastewater treatment processes.
• integrate various unit processes and operations into an overall treatment train.

Unit 3 (Weeks 4-5): Physical, Chemical, Biological Characteristics of Pollution

Students should be able to know the various analytical procedures and limitations associated with the measurement of the following water quality parameters **:**
• BOD, NOD
• COD, TOC, THOD
• VSS, TSS
• MLSS
• MPN
• Toxicity carcinogens
• Coliforms

Unit 4 (Week 6): - Preliminary Treatment

At the end of this unit, students should be familiar with the design principles for preliminary processes including screening, comminution, and various grit removal technologies including aerated grit chambers, and centrifugal grit removal technologies.

Unit 5 (Week 7): Primary Treatment
At the end of this section, students should be able to:

- Know the various types of clarifier designs such as regular clarifiers, tube settlers, and sludge blanket clarifiers
- Identify the various primary clarifiers design parameters and their typical ranges
- Determine TSS and BOD removal efficiencies in primary clarifications and the parameters impacting process performance
- Extrapolate from laboratory-scale data to full-scale design data

Unit 6 (Week 8-10): Biological Treatment Processes
At the end of this section, students will:

- gain a good understanding of the bacterial growth kinetics in biological treatment systems
- understand the fundamentals of suspended-growth kinetics
- apply the fundamentals of biological treatment to the design of activated sludge systems
- be able to understand the various configurations of the activated sludge process
- design attached growth processes like trickling filters and rotating biological contactors, both based on treatability data, and semi-empirical design parameters

Unit 7 (Weeks 11-12): Disinfection
At the end of this unit, students will be able to :

- understand the implications of the concept of dose, and contact time in disinfection
- understand the chemistry of aqueous chlorine, its dissociation products, and disinfection power
- design disinfection processes based on process kinetics and disinfectant residuals
- compare various disinfectants from both efficacy and environmental impact standpoints

Unit 8 (Weeks 12-13): Sludge Treatment and Anaerobic Digestion
At the end of this unit, students will:

- Have an overall understanding of the functions of various biosolids processes in the management of wastewater solids
- Be able to design anaerobic digestion systems and estimate energy production
- Evaluate the quality of processed biosolids for land disposal

Graduate Attribute Assessment and Mapping to Course Learning Outcomes:
Problem Analysis: a-development of treatment processes to meet criteria (unit 2); b- design various treatment processes and assess the impact of process variables on performance (units 4-8)
Impact of engineering on society and environment: a- understanding of pertinent environmental regulations (unit 1); b-comparison of various disinfectants to mitigate environmental impacts (unit 7)

Accreditation (AU) Breakdown
Engineering Science = 70%
Engineering Design = 30%

Evaluation
The final course mark will be determined as follows:
Assignments 25%
Mid Term Examination 25% -- Academic consideration will not be given for this assessment without appropriate documentation
Final Examination 50%
Both the mid-term and final examination are open book and are in-person. The final examination is 3 hours long.

Notes

1) Students must pass the final examination to pass this course. Students who fail the final examination will be assigned 48% if the aggregate mark is higher than 50%, or the aggregate mark.

2) Assignments are to be submitted in class on the specified due date.

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