Western University – Faculty of Engineering
Department of Civil and Environmental Engineering

CEE CEE 4416A/B – Digital Water Infrastructures – Course Outline 2025/26

This course is designed to provide undergraduate students with a hands-on understanding of the technologies and methodologies driving the digital transformation of water infrastructure. It covers essential components of digital solutions, including smart instrumentation, data and metadata management, preprocessing techniques, and data-driven modeling. Through a hands-on project, students will engage with data-driven digital solutions such as soft sensors, predictive modeling, and advanced process control strategies to optimize system performance, enhance climate resilience, promote equity in water access and management, and support resource sustainability. Combining lectures, case studies, and practical exercises, the course equips learners with critical skills in environmental data handling, the development of data-driven solutions, and intelligent decision-making for next-generation water infrastructure.

Calendar Copy:
Application of Data Analytics/Machine Learning in urban water including drinking water, wastewater and stormwater infrastructure design, operation and maintenance to achieve resilient, sustainable and cost-effective water management.

Prerequisites:
CEE 3355A/B, CEE 3362A/B.

Antirequisites:
None.

Corequisites:
None.

Note: It is the student's responsibility to ensure that all Prerequisite and Corequisite conditions are met or that special permission to waive these requirements has been granted by the Faculty. It is also the student's responsibility to ensure that they have not taken a course listed as an Antirequisite. The student may be dropped from the course or not given credit for the course towards their degree if they violate the Prerequisite, Corequisite or Antirequisite conditions.

Contact Hours:
2 lecture hours/week (required);
2 tutorial hours/week;
Tutorials are not mandatory but students seeking assistance with projects or clarification on lecture material are strongly encouraged to attend.
Additional self-study: 4 hours/week.

Instructor:


Textbook:
None

Other References:
Grievson, O., Holloway, T., Johnson, B. (Eds.), 2022. A Strategic Digital Transformation for the Water Industry. IWA Publishing. https://doi.org/10.2166/9781789063400
(Free online version, to buy print book is 75.00 USD)
Villez, K., Aguado, D., Alferes, J., Plana, Q., Ruano, M., Samuelsson O. (Eds.), 2024. Metadata Collection and Organization in Wastewater Treatment and Wastewater Resource Recovery Systems. IWA Publishing. https://doi.org/10.2166/9781789061154
(Free online version, to buy print book is 156.00 USD)
Araghinejad, S., 2014. Data-Driven Modeling: Using MATLAB® in Water Resources and Environmental Engineering, Water Science and Technology Library. Springer Netherlands, Dordrecht. https://doi.org/10.1007/978-94-007-7506-0
(Free online version, to buy print book is 64.99 USD)
Olsson, G., Ingildsen, P., 2023. Process control. https://doi.org/10.2166/9781789060362_0667
(Free online version, to buy print book is 125.00 USD)

Units:
Both SI and FPS unit systems may be used in lectures, laboratories, tutorials and examinations.

Specific Learning Objectives:
The lectures and tutorial assignments will prepare students to do the following **[GA Indicator]**:

- Understand and explain the key components of digital solutions in water infrastructure **[KB4]** and its impacts on the society and the environment **[IESE1, IESE2]**.
- Apply data management and modeling techniques to analyze and improve the performance of the water infrastructure **[I3, ET2, ET3]**.
- Design and deliver data-driven solutions and process control strategies for the water infrastructure **[D1, D2, D4]**.
- Evaluate the effectiveness and limitations of digital solutions in promoting resilience, sustainability, and equity **[IESE3, EE3, LL1]**.
- Communicate technical findings clearly through written reports and oral presentations **[CS1, CS2, CS3, ITW1, ITW2]**.

The instructor may expand, or revise material presented in the course as appropriate.

General Learning Objectives:

E=Evaluate, T=Teach, I=Introduce; (Introductory, Developing or Advanced level)

Knowledge Base	E (D)	Engineering Tools	T	Impact on Society	I
Problem Analysis	T	Team Work	T	Ethics and Equity	I
Investigation		Communication	T	Economics and Project Management	
Design	T	Professionalism		Life-Long Learning	I

Accreditation Units:
Engineering Science = 100%

Evaluation:

The final course grade will be determined as follows:

Assignments (3)	15 %
Student-led in-class activities (3)	15 %
Participation	5 %
Paper review & Presentation	15%
Project Preliminary presentation	10%
Project documentation of code/dataset	10%
Final project report	15%
Final project presentation	15 %
Total	100 %

Notes**:**

Students who have failed this course previously 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.

1. Assignments (15%):
   Three assignments will cover a range of course topics. Assignments are to be submitted prior to the due date to OWL.

2. Paper review & Presentation (15%):
   In groups, Students will be assigned a research article on an existing Digital Water Solution and asked to deliver a presentation on Week 9-, and two-pages report on Week 10. Detailed instructions and exact date will be announced at least 4 weeks in advance.

3. Student-led activities (15%):
   One week ahead of class time, students will be required to prepare a presentation/report on or do research to debate specific topics in Class.

4. Participation (5%):
   Participation will be assessed based on participation in lectures and tutorials.

5. Project (50%):
   Students will be asked to identify a problem and develop a digital solution to address it.
   Students are welcomed to reach out to municipalities to obtain data, meanwhile, few public datasets will be shared with the students in the first week.
   - Preliminary presentation should focus on identifying the problem and how a digital solution is needed.
   - Final Report and presentation shall detail the solution and cover all components of a digital solution.

I. Missed/Late Accommodation Policy:

1. Students missing a test/assignment/lab or examination you will report the absence by submitting Academic Consideration Request form through STUDENT ABSENCE PORTAL.
2. Documentation must be provided as soon as possible.

II. 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 (see next page for information on 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.

III. Late Assignments:

1. Students must advise the course instructor if they are having difficulty completing an assignment on time (prior to the due date of the assignment).
2. Students should be prepared to submit the Academic Consideration Request Form and provide documentation if requested to do so by the course instructor (see reverse side for information on documentation).
3. If granted an extension, a revised due date should be established with the course instructor. 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.
4. This course has 10 assignments with only 8/10 assignments counted towards your final grade. Academic consideration will not be granted for missed assignments. If students miss 2/10 assignments, the remaining 8 assignments will be used in the calculation of the final grade. If students miss more than 2 assignments, they will receive a grade of zero on each missed assignment.
5. This course employs flexible deadlines for assignments. The assignment deadlines can be found above in the course outline. For each assignment, students are expected to submit the assignment by the deadline listed. Should illness or extenuating circumstances arise, students are permitted to submit their assignment up to 72 hours past the deadline without academic penalty. Should students submit their assessment beyond 72 hours past the deadline, a late penalty of XX% per day will be subtracted from the assessed grade. As flexible deadlines are used in this course, requests for academic consideration will not be granted. If you have a long-term academic consideration or an accommodation for disability that allows greater flexibility than provided here, please reach out to your instructor at least one week prior to the posted deadline.
6. Extensions beyond the end of classes must have the consent of the instructor, the department Chair and the Associate Dean, Undergraduate Studies. Documentation is mandatory.

Note: Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).

IV. 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 the first/one absence*)
   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.**

5. 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. Academic consideration may include extension of deadlines, waiver of attendance requirements for classes/labs/tutorials, or re-weighting of course requirements. Some forms of academic consideration, such as arranging Special Examinations, assigning a grade of Incomplete, or granting late withdrawals without academic penalty, may only be granted by the Academic Advising office of the Faculty of Engineering.

V. 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.

VI. 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

VII. 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

VIII. 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. However, the use of GenAI tools in any assignment or contribution during the course will have to be disclosed, as a resource.
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.

IX. 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.

X. 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.

XI. 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.

XII. 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