

**Western University - Faculty of Engineering
Department of Civil and Environmental Engineering**

CEE 4476B – Environmental Hydraulics Design - Course Outline 2025

This course applies the principles of hydraulics and fluid mechanics to environmental flows of water in open channels. At the end of this course students will be able to:

- Identify, formulate, and analyze environmental hydraulics of open channel flows
- Apply knowledge of hydraulics and fluid mechanics to the analysis and design of hydraulic structures and river flows
- Plan, and design, and interpret the results of a laboratory investigation in support of a design project in a small group
- Improve communication skills by contributing to the preparation of comprehensive reports and an oral presentation
- Develop an awareness of water resources issues surrounding environmental flows in open channel waters, and appreciate professional responsibility issues
- Creatively solve problems individually and in small groups

Calendar Copy:

The application of hydraulic engineering principles in the analysis of environmental flows. Topics include: open channel transitions, flow measuring devices, stabilization of a natural river, flood control channels, spillways and stilling basins, culverts, and sediment transport in alluvial channels.

Prerequisites:

CEE 2224

Antirequisites:

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, 1 laboratory hours, and 2 tutorial hours per week.

Attendance at the tutorial/laboratory session is **mandatory**.

Instructor:

Dr. M. Reza Najafi

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Phone: ext. 86428

Administrative Assistant: Sandra McKay (smckay@uwo.ca)

Textbook:

The required text for this class is:

- Sturm, T. *Open Channel Hydraulics, 3rd Edition*. McGraw-Hill Higher Education, 2021. Can be purchased at the bookstore or Amazon.

Other References

- Chanson H., *Hydraulics of Open Channel Flow, 2nd Edition*. Butterworth-Heinemann, 2004.
- Chanson H., *Environmental Hydraulics for Open Channel Flows*. Butterworth-Heinemann, 2004.
- French R., *Open Channel Hydraulics*. Water Resources Publications, 2007.

Active Engaged Classroom:

It is important for the students to attend the class and actively participate in different activities that are set to encourage engaged learning. Web-browsing, texting, and social media are not allowed during class time as they will distract other students.

Units:

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

Specific Learning Objectives [GA Indicator – bold denotes evaluated indicator]:

1. *Basic Principles* [PA1]

- Classify different types of flow regimes in open channel hydraulics
- Demonstrate an understanding of the important concepts in fluid mechanics (continuity, momentum and energy equations)

2. *Specific Energy* [**PA1, KB2**]

- Describe and compute the specific energy diagram and critical depth in simple and complex channel cross-sections
- Apply the governing equations for open channel contractions and expansions with head loss
- Determine the discharge range of critical depths in overbank flow conditions
- Apply weirs in the design of open channel flow measuring devices
- Apply the energy equation in stratified flows

3. *Momentum* [**PA1, DE1, KB2**]

- Apply the momentum equation in open channel flows for the analysis of hydraulic jumps
- Design a stilling basin to stabilize hydraulic jumps
- Analyze the occurrence of surges in open channel hydraulics
- Apply momentum analysis to backwater effects caused by flow obstructions

4. *Uniform Flow* [PA1, DE1]

- Describe the flow resistance in turbulent open channel flows and the resulting velocity distributions for various hydraulic conditions

- Compute uniform flow depth in simple and compound channels
 - Design channels with flexible linings, flood control and flood diversion channels
5. *Gradually Varied Flow* [PA1, IN3, DE1, **KB2**]
- Describe gradually varied flows and apply the related equations
 - Classify water surface profiles
 - Compute water surface profiles in artificial and natural channels
 - Use HEC-RAS to compute water surface profiles
6. *Hydraulic Structures* [PA1, IN2, **DE1**, DE2, **DE4**, **KB2**]
- Design spillways to transfer large flood discharges safely downstream from a reservoir
 - Describe and apply methods for computing bridge backwater effects
7. *Unsteady Flow* [PA1, DE1]
- Describe the development and application of dynamic wave equations
 - Apply the Saint-Venant equations to characterize unsteady flow conditions
8. *Flow in Alluvial Channels* [PA1, IN3, DE1, DE2, DE4]
- Compute the fall velocity of sediment in water for various conditions
 - Determine the stability of the bed and banks of natural alluvial channels by evaluating the threshold of sediment movement
 - Predict bed-load transport and the total sediment discharge of an alluvial stream
 - Estimate streambed adjustments and scour
9. *Laboratory Investigation* [**IN2**, **IN3**, DE1, **DE2**, DE4, **KB2**]
 Plan, design and interpret a laboratory investigation in support of a design project
 Instructor may expand on material presented in the course as appropriate

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

General Learning Objectives:

E=Evaluate, T=Teach, I=Introduce, (D) = Developing, (A) = Advanced level

Problem Analysis	E (A)	Teamwork	I	Ethics and Equity	
Investigation	E (A)	Communication	I	Economics and Project Management	
Design	E (A)	Professionalism		Life-Long Learning	
Engineering Tools	T	Impact on Society	T	Knowledge base	T

Evaluation:

The final mark will be determined as follows:

Participation	10 %
Assignments	15 %
Laboratory Project	15 %
Midterm	15 %

Final Examination	<u>45 %</u>
Total	100 %

Note: Participation will be tracked through forum posts and discussions during lecture hours.

1. Quizzes and Examinations:

A 90-minute midterm exam will be held during tutorial hours. A three-hour final examination will take place during the examination period. Programmable calculators are not permitted in the final exam and tests. Both tests and the final examination will be Closed Book. A list of acceptable calculators for closed book exams will be posted on the bulletin board across from the Department of Civil and Environmental Engineering Office: please be sure your calculator is on it!

2. Weekly Assignments:

Assignments will be given on a weekly basis. Assignments are to be submitted prior to the due date to OWL. Late assignments will be assessed a penalty of 10% per day, to a maximum of 4 days, after which they will receive a mark of zero. Extensions are to be negotiated with the course instructor, not the teaching assistants.

3. Laboratories:

Students in small groups will plan, design and carry out a laboratory investigation of an environmental hydraulics problem. At the end of the course each group is required to submit a final report (~3000 words) and make a 10-min oral presentation. An additional progress report (1000 words) must also be submitted by each group for review and marking. A Logbook of group activities related to the project must be maintained and submitted as an attachment to the progress and final reports. Contributions by individual members of a group must be clearly identified in the Logbook and in the progress and final reports.

4. 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 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.

CEE Course Outline Additional Information

The sections below can be included following the “Evaluation” section of the sample course outline (replacing the red text in the course outline template). Text in blue below should appear in all course outlines. Text in red will be applicable to some courses and not to others.

Cheating:

University policy states that cheating is a scholastic offence. The commission of a scholastic offence is attended by academic penalties that might include expulsion from the program. If you are caught cheating, there will be no second warning.

For more information on scholastic offenses, please see:

http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_undergrad.pdf

Attendance:

Any student who, in the opinion of the instructor, has not engaged sufficiently in class, laboratory, or 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 taking the regular final examination in the course.

Accommodation:

Students with disabilities work with Accessible Education (formerly SSD) which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The accommodation policy can be found here: [Academic Accommodation for Students with Disabilities](#).

Academic Consideration for Student Absence

Students will have up to two (2) opportunities during the regular academic year to use an on-line portal to self-report an absence during the term, provided the following conditions are met: the absence is no more than 48 hours in duration, and the assessment for which consideration is being sought is worth 30% or less of the student's final grade. Students are expected to contact their instructors within 24 hours of the end of the period of the self-reported absence, unless noted on the syllabus. Students are not able to use the self-reporting option in the following circumstances:

- for exams scheduled by the Office of the Registrar (e.g., December and April exams)
- absence of a duration greater than 48 hours,
- assessments worth more than 30% of the student's final grade,
- if a student has already used the self-reporting portal twice during the academic year

If the conditions for a Self-Reported Absence are *not* met, students will need to provide a Student Medical Certificate if the absence is medical, or provide appropriate documentation if there are compassionate grounds for the absence in question. Students are encouraged to contact their Faculty academic counselling office to obtain more information about the relevant documentation.

Students should also note that individual instructors are not permitted to receive documentation directly from a student, whether in support of an application for consideration on medical grounds, or for other reasons. **All documentation required for absences that are not covered by the Self-Reported Absence Policy must be submitted to the Academic Counselling office of a student's Home Faculty.**

For Western University policy on Consideration for Student Absence, see

Policy on Academic Consideration for Student Absences - Undergraduate Students in First Entry Programs

and for the Student Medical Certificate (SMC), see:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf.

Religious Accommodation

Students should consult the University's list of recognized religious holidays, and should give reasonable notice in writing, prior to the holiday, to the Instructor and an Academic Counsellor if their course requirements will be affected by a religious observance. Additional information is given in the [Western Multicultural Calendar](#).

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. Please turn off your cell phone before coming to a class, tutorial, quiz or exam. On the premises of the University or at a University-sponsored program, students must abide by the Student Code of Conduct: <http://www.uwo.ca/univsec/board/code.pdf>

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 as determined by the course instructor.