

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

**CEE 4476b – Environmental Hydraulics Design - Course Outline**

**Learning Outcomes**

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, design, and conduct 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

**Prerequisite**

CEE 2224

**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.

Lecture

Wednesday 9:30 pm – 11:30 am  
SEB-2099

Tutorial

Tuesday 2:30 pm - 4:30 pm  
AHB-2B02

Laboratory

Wednesday 9:30 am - 11:30  
am  
SEB-029

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

**Instructor**

Dr. Mohammad Reza Najafi

Office: CMLP 1301

Email: [mnajafi7@uwo.ca](mailto:mnajafi7@uwo.ca)

Phone: ext. 86428

*Administrative Support:* Ms. Sandra McKay, Room 3005

### **Textbooks**

The required text for this class is:

- Sturm, T. *Open Channel Hydraulics, 2nd Edition*. McGraw-Hill Higher Education, 2010. 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.

### **Laboratory Design Project**

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.

### **Units**

SI units will be used in lectures and examinations

### **Specific Learning Objectives**

#### 1. *Basic Principles*

- 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*

- 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*

- 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*

- 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*

- 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*

- Design spillways to transfer large flood discharges safely downstream from a reservoir
- Describe and apply methods for computing bridge backwater effects

### 7. *Unsteady Flow*

- Describe the development and application of dynamic wave equations
- Apply the Saint-Venant equations to characterize unsteady flow conditions

### 8. *Flow in Alluvial Channels*

- 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.*

Plan, design and conduct a laboratory investigation in support of a design project  
Instructor may expand on material presented in the course as appropriate.

### **General Learning Objectives**

E=Evaluate, T=Teach, I=Introduce

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

## **Quizzes and Examinations**

Two 60 minute quizzes will be scheduled during tutorial periods. A 3-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!

## **Weekly Assignments**

Problems and nine (9) assignments will be discussed in the tutorials. Each assignment will have a Part A which must be turned in by each student by the end of the tutorial period. The assignments will be posted on OWL and will be due on Tuesdays. Assignments must be submitted for marking by 4:30 pm on the due date, in locker 70 on the second floor (Spencer Engineering Building). Some assignments may include laboratory components. Late assignments will receive a grade of zero. Extensions are to be negotiated with the course instructor, not the teaching assistants.

## **Evaluation**

The final grade will be computed as follows:

Assignments	15%
Laboratory project	15%
Midterm	20%
Final Exam	50%
-----	
TOTAL	100%

**(a) Students must pass the final examination to pass this course.** Students who fail the final examination will be assigned the aggregate mark, as determined above, or 48%, whichever is less.

**(b) Students must turn in all laboratory reports, and achieve a passing grade in the laboratory component, to pass this course.** Students who do not satisfy this requirement will be assigned 48% or the aggregate mark, whichever is less.

**(c) 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.

**(d)** Should any of the quizzes conflict with a religious holiday that a student wishes to observe, the student must inform the instructor of the conflict no later than two weeks before the scheduled test.

(For further information on Accommodations for Religious Holidays see

[https://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/accommodation\\_religious.pdf](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf))

### **3. 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.

### **Plagiarism Checking**

The Western University uses software for plagiarism checking. Students are required to submit their Laboratory Reports in electronic form to Turnitin.com for plagiarism checking.

### **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:

[https://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/scholastic\\_discipline\\_undergrad.pdf](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf)

### **Attendance**

Any student who, in the opinion of the instructor, is absent too frequently from 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.

### **Accessibility**

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.

### **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. Late comers may be asked to wait outside the classroom until being invited in by the Instructor. 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:

<https://www.uwo.ca/univsec/pdf/board/code.pdf>

### **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 (see attached). 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.

For more information concerning medical accommodations, please see:

[https://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/accommodation\\_medical.pdf](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf)

### **Notice:**

Students are responsible for regularly checking their email, course website (<https://owl.uwo.ca>) and notices posted outside the Civil and Environmental Engineering Department Office

### **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.

### **Course Breakdown**

Engineering Science = 50%; Engineering Design = 50%

The document “INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED” is part of this course outline.