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	*Tutorial*	*Laboratory*
Thursday 8:30 am – 10:30 am UCC-59	Tuesday 10:30 am - 12:30 pm UCC-59	Tuesday 2:30 pm - 3:30 pm SEB-1056

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

Instructor

Dr. Mohammad Reza Najafi
Office: SEB 2053
Email: 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. Clickers will be used in this class to promote active 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.* At the end of this section, the student should be able to:
a) Classify different types of flow regimes in open channel hydraulics
b) Demonstrate an understanding of the important concepts in fluid mechanics (continuity, momentum and energy equations)

2. *Specific Energy*. At the end of this section, the student should be able to:
a) Describe and compute the specific energy diagram and critical depth in simple and complex channel cross-sections
b) Apply the governing equations for open channel contractions and expansions with head loss
c) Determine the discharge range of critical depths in overbank flow conditions
d) Apply weirs in the design of open channel flow measuring devices
e) Apply the energy equation in stratified flows

3. *Momentum*. At the end of this section, the student should be able to:

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

4. *Uniform Flow*. At the end of this section, the student should be able to:
a) Describe the flow resistance in turbulent open channel flows and the resulting velocity distributions for various hydraulic conditions
b) Compute uniform flow depth in simple and compound channels
c) Design channels with flexible linings, flood control and flood diversion channels

5. *Gradually Varied Flow*. At the end of this section, the student should be able to:
a) Describe gradually varied flows and apply the related equations
b) Classify water surface profiles
c) Compute water surface profiles in artificial and natural channels
d) Use HEC-RAS to compute water surface profiles

6. *Hydraulic Structures*. At the end of this section, the student should be able to:
a) Design spillways to transfer large flood discharges safely downstream from a reservoir
b) Describe and apply methods for computing bridge backwater effects

7. *Unsteady Flow*. At the end of this section, the student should be able to:
a) Describe the development and application of dynamic wave equations
b) Apply the Saint-Venant equations to characterize unsteady flow conditions

8. *Flow in Alluvial Channels*. At the end of this section, the student should be able to:
a) Compute the fall velocity of sediment in water for various conditions
b) Determine the stability of the bed and banks of natural alluvial channels by evaluating the threshold of sediment movement
c) Predict bed-load transport and the total sediment discharge of an alluvial stream
d) 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 (Beginner or Intermediate or Advanced Level)

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

Quizzes and Examinations

Two 60 minute quizzes will be scheduled during tutorial periods on February 9 and March 23. A 3-hour final examination will take place during the final examination period. Programmable calculators are **not** permitted in the final exam and tests. Both tests and the final examination will be **CLOSED BOOK: no programmable calculators or other external sources of information, including books, notes or crib sheets, are permitted.** 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! **Part marks may not be awarded for some of the problems on the tests or final exam.**

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 Wednesdays. 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	10%
Laboratory project	15% (Progress report 4%, Presentation 3%, Final report 8%)
Quiz #1	10%
Quiz #2	10%
Participation in Classroom Activities	5%
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)

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

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

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 SUBMINT ASSIGNMENTS AS SCHEDULED” is part of this course outline.

Western University
Faculty of Engineering
2016-2017

INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED

If, on medical or compassionate grounds, you are unable to write term tests or final examinations or complete course work by the due date, you should follow the instructions listed below. You should understand that academic accommodation will not be granted automatically on request. You must demonstrate to your department (or the Undergraduate Services office if you are in first year) that there are compelling medical or compassionate grounds that can be documented before academic accommodation will be considered. Different regulations apply to term tests, final examinations and late assignments. Read the instructions carefully. (see the 2016 Western Academic Calendar).

A. *GENERAL REGULATIONS & PROCEDURES*

1. Check the course outline to see if the instructor has a policy for missed tests, examinations, late assignments or attendance.

2. Bring your request for academic accommodation to the attention of the Chair of the department (or the Undergraduate Services office if you are in first year) prior to the scheduled time of the test or final examination or due date of the assignment. If you are unable to contact the relevant person, leave a message with the appropriate department (or Undergraduate Services office, if you are in first year). The addresses, telephone and fax numbers are given at the end of these instructions. Documentation must be provided as soon as possible.

3. If you decide to write a test or an examination you should be prepared to accept the mark you earn. Rewriting tests or examinations or having the value of a test or exam reweighted on a retroactive basis is not permitted.

B. *TERM TESTS*

1. If you are unable to write a term test, inform your instructor and the Chair of your Department (or the Undergraduate Services Office if you are in first year) prior to the scheduled date of the test. If the instructor is not available, leave a message for him/her at the department office and inform the Chair of the Department (or the Undergraduate Services Office if you are in first year).

2. Be prepared to provide supporting documentation to the Chair and the Undergraduate Services Office (see next page for information on documentation).

3. Discuss with the instructor if and when the test can be rescheduled. **N.B.** The approval of the Chair (or the Undergraduate Services Office if you are in first year) is required when rescheduling term tests.

C. *FINAL EXAMINATIONS*

1. If you are unable to write a final examination, contact the Undergraduate Services Office PRIOR TO THE SCHEDULED EXAMINATION TIME to request permission to write a Special Final Examination. If no one is available in the Undergraduate Services Office, leave a message clearly stating your name & student number (please spell your full name).

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, 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 sign a "Recommendation for a Special Examination Form" available in the Undergraduate Services Office. The Undergraduate Services Office will then notify the course instructor(s) and reschedule the examination on your behalf.

N.B. **It is the student's responsibility to check the date, time and location of the special examination.**

D. *LATE ASSIGNMENTS*

1. Advise the instructor if you are having problems completing the assignment on time (**prior** to the due date of the assignment).
2. Be prepared to provide documentation if requested by the instructor (see reverse side for information on documentation).
3. If you are granted an extension, establish a due date. The approval of the Chair of your Department (or the Associate Dean if you are in first year) is not required if assignments will be completed prior to the last day of classes.
4. i) Extensions beyond the end of classes must have the consent of the instructor, the department Chair and the Associate Dean. Documentation is mandatory.
   ii) A Recommendation of Incomplete Form must be filled out indicating the work to be completed and the date by which it is due. This form must be signed by the student, the instructor, the department Chair and the Associate Dean.

SHORT ABSENCES

If you miss a class due to a minor illness or other problems, check your course outlines for information regarding attendance requirements and make sure you are not missing a test or assignment. Cover any readings and arrange to borrow notes from a classmate.

EXTENDED ABSENCES

If you are absent more than one week or if you get too far behind to catch up, you should consider reducing your workload by dropping one or more courses. (Note drop deadlines listed below). You may want to seek advice from the academic counsellor in your Department or the counsellors in the Undergraduate Services Office if you are in first year.

DOCUMENTATION

If you consulted an off-campus doctor or Student Health Services regarding your illness or personal problem, you must provide the doctor with a Student Medical Certificate to complete at the time of your visit and then bring it to the Department (or the Undergraduate Services Office if you are in first year). **This note must contain the following information: severity of illness, effect on academic studies and duration of absence.**

In Case of Serious Illness of a Family Member: Provide a Student Medical Certificate to your family member's physician to complete and bring it to the Department (or the Undergraduate Services Office if you are in first year).

In Case of a Death: Obtain a copy of the death certificate or the notice provided by the funeral director's office. You must include your relationship to the deceased and bring it to the Department (or the Undergraduate Services Office if you are in first year).

For Other Extenuating Circumstances: If you are not sure what documentation to provide, ask the Departmental Office (or the Undergraduate Services Office if you are in first year) for direction.

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

ACADEMIC CONCERNS

You need to know if your instructors have a policy on late penalties, missed tests, etc. This information may be included on the course outlines. If not, ask your instructor(s).

You should also be aware of attendance requirements in some courses. You can be debarred from writing the final examination if your attendance is not satisfactory.

If you are in academic difficulty, check out the minimum requirements for progression in the calendar. If in doubt, see your academic counsellor.

Calendar References: Check these regulations in your 2016 Western Academic Calendar available at www.westerncalendar.uwo.ca.

Absences Due to Illness - page 117
Academic Accommodations for Students with Disabilities - page 118
Academic Accommodations for Religious Holidays - page 119
Incomplete Standing - page 104
Scheduling of Term Assignments – page 97
Scholastic Offences - page 113
Special Examinations - page 132

Note: These instructions apply to all students registered in the Faculty of Engineering regardless of whether the courses are offered by the Faculty of Engineering or other faculties in the University.

***Drop Deadlines*:**		
	First term half course (i.e. “A” or “F”):	November 5, 2016
	Full courses and full-year half courses (i.e. “E”, “Y” or no suffix):	November 30, 2016
	Second term half or second term full course (i.e. “B” or “G”):	March 7, 2017

Undergraduate Services Office:	SEB	2097	telephone: (519) 661-2130	fax: (519) 661-3757
Dept. of Chemical and Biochemical Engineering:	TEB	477	telephone: (519) 661-2131	fax: (519) 661-3498
Dept. of Civil and Environmental Engineering:	SEB	3005	telephone: (519) 661-2139	fax: (519) 661-3779
Dept. of Electrical and Computer Engineering, Software Engineering Mechatronics Engineering	TEB	279	telephone: (519) 661-3758	fax: (519) 850-2436
Dept. of Mechanical and Materials Engineering:	SEB	3002	telephone: (519) 661-4122	fax: (519) 661-3020