CIV E 739 Advanced Topics in Fluid Mechanics and Hydraulics

Winter 2026 - January 05 to April 15

Class time: Monday, Wednesday 9:30-10:50 Location: NRE 2-080

Instructor:

Vincent McFarlane, PhD, P.Eng, he/him

vincent.mcfarlane@ualberta.ca
Donadeo Innovation Centre For Engineering 7-306
Office Hours: TBD

Course Description:

*3 (fi) (either term, 3-0-0",)

Prerequisites: An undergraduate course on fluid mechanics and/or hydraulics

Course synchronous and asynchronous content delivery schedule:

All course content will be delivered synchronously in the classroom.

Land Acknowledgment:

The University of Alberta respectfully acknowledges that we are located on Treaty 6 territory, a traditional gathering place for diverse Indigenous peoples including the Cree, Blackfoot, Métis, Nakota Sioux, Iroquois, Dene, Ojibway/ Saulteaux/Anishinaabe, Inuit, and many others whose histories, languages, and cultures continue to influence our vibrant community.

TA Information:

N/A

Course Objectives & General Content:

The course objectives are 1) to learn and understand the general principles of various types of open channel flow, 2) to analyse and solve various practical open channel flow problems, 3) to conduct various aspects of open channel design, and 4) to gain experience with developing 1D and 2D numerical open channel flow models.

The general contents are:
1. Basic concepts of open channel flow
2. Steady flow conservation laws
3. Critical flow
4. Uniform flow
5. Gradually varied flow
6. Rapidly varied flow
7. Unsteady flow

8. Governing equations for one-dimensional flow
9. Two-dimensional flow
10. 1D and 2D modelling in HEC-RAS

Learning Outcomes:

By the end of this course, students should be able to:

1. Describe different open channel flow conditions including uniform flow, gradually varied flow, rapidly varied flow, steady flow, and unsteady flow.
2. Analyse theoretical and practical open channel flow problems.
3. Apply fundamental knowledge learned in this course to solve practical design problems.
4. Describe the governing equations for one- and two-dimensional flow.
5. Implement best practices to develop a 1D or 2D open channel flow model.

Marking Scheme:

Activity	(A)Synchronous	Due/Scheduled	Weight
Kahoot! Quiz Participation	Synchronous	Throughout the term	10%
Assignments	Synchronous	Throughout the term	15%
Project Pitch Presentation	Synchronous	Early February	10%
Project Literature Summary	Synchronous	Late February/Early March	10%
Project Final Presentation	Synchronous	Final week of classes	15%
Final Exam	Synchronous	TBD by Registrar	40%

Instructors have the leeway to deviate from this average and can assign grades based on their own scheme. All grades are approved by the department chair (or delegate). The office of the Dean has final oversight on all grades.

Term Work

All term work solutions will be posted no later than the last day of classes. All term work will be returned to students by the final day of classes, with the exception of major term work due in the last week of classes. The latter will be returned by the day of the final examination or the last day of the examination period if there is no final examination in the course as per university policy; instructors will make accommodations to return these term work. It is the responsibility of the student to pick up all their term work at the specified time and place. Any unreturned term work, shall be retained and then shredded six months after the deadline for reappraisal and grade appeals. Final examinations will be kept for one year as required by university guidelines and the Government of Alberta's Freedom of Information and Protection of Privacy Act.

Calculator Policy

There is no calculator policy in this course; students are free to use the calculator they wish for all assessments.

Expectations for AI use

In this course, our primary focus is to cultivate an equitable, inclusive, and accessible learning community that emphasizes individual critical, creative, and affective thinking as well as disciplinary problem-solving skills. While it is reasonable to assume AI-use might accelerate some aspects of coursework, the determination has been made to not use such tools. In order to achieve the identified course learning outcomes, students must be given learning opportunities and tasks which enable students to develop and demonstrate their skills and knowledge across course and discipline specific projects, assignments, and assessments.

To ensure a just and consistent learning experience for all students, the use of advanced AI-tools such as ChatGPT or Dall-E 2 is strictly prohibited for all academic (written/coding/creative/etc.) work, assignments, and assessments in this course. Each student is expected to complete all tasks without substantive assistance from others, including AI-tools.

IMPORTANT: Please note that AI use is strictly prohibited in course work, assignments, and assessments. Failure to abide by this guideline may be considered an act of cheating and a violation as outlined in the relevant sections of University of Alberta (November 2022) Code of Student Behaviour .

Text and References (Mandatory):

Chaudhry, M.H., 2022. Open-Channel Flow, 3rd ed. Springer International Publishing. https://doi.org/10.1007/978-3-030-96447-4

Available free as an ebook from the U of A Library. Hardcopy available for order online https://link.springer.com/book/10.1007/978-3-030-96447-4

Text and References (Recommended):

Chow, V. T., 1959. Open-Channel Hydraulics. McGraw-Hill, New York.
Henderson, F.M., 1966. Open Channel Flow. Macmillan, New York.
Sturm, Terry W. 2021. Open Channel Hydraulics. 3rd ed. McGraw-Hill, New York.
Tollner, E.W., 2021. Open Channel Design: Fundamentals and Applications. Wiley-Blackwell, Hoboken, NJ.

Website:

Canvas

Previous Examples of Evaluative Materials:

A sample exam will be provided in advance of the final exam date.

Did you know that the University of Alberta has various low-to-no-cost services to help students succeed? Visit http://www.deanofstudents.ualberta.ca/ for information about the academic, wellness, and various other support services available to U of A students. It's never too early or too late to seek help!

University and faculty policies

Respect and professionalism

The Faculty of Engineering is committed to fostering and protecting an equitable, inclusive, and respectful work and study environment in line with University of Alberta policies and professional engineering industry standards.

The faculty prepares students to uphold industry standards to become a Professional Engineer (P.Eng). Therefore, respect, professionalism, and accountability must be upheld within the Faculty of Engineering and the University of Alberta.

Academic integrity and student conduct

The University of Alberta is committed to the highest standards of academic integrity and honesty, as well as maintaining a learning environment that fosters the safety, security, and the inherent dignity of each member of the community, ensuring students conduct themselves accordingly. Students are expected to be familiar with the standards of academic honesty and appropriate student conduct, and to uphold the policies of the University in this respect.

Students are particularly urged to familiarize themselves with the provisions of the Student Academic Integrity Policy and the Student Conduct Policy, and avoid any behaviour that could

potentially result in suspicions of academic misconduct (e.g., cheating, plagiarism, misrepresentation of facts, participation in an offence) and non-academic misconduct (e.g., discrimination, harassment, physical assault). Academic and non-academic misconduct are taken very seriously and can result in suspension or expulsion from the University.

All students are expected to consult the Academic Integrity website for clarification on the various academic offences. All forms of academic dishonesty are unacceptable at the University. Unfamiliarity of the rules, procrastination or personal pressures are not acceptable excuses for committing an offence. Listen to your instructor, be a good person, ask for help when you need it, and do your own work -- this will lead you toward a path to success. Any academic integrity concern in this course will be reported to the College of Natural and Applied Sciences. Suspected cases of non-academic misconduct will be reported to the Dean of Students. The College, the Faculty, and the Dean of Students are committed to student rights and responsibilities, and adhere to due process and administrative fairness, as outlined in the Student Academic Integrity Policy and the Student Conduct Policy. Please refer to the policy websites for details on inappropriate behaviours and possible sanctions.

The College of Natural and Applied Sciences (CNAS) has created an Academic Integrity for CNAS Students eClass site. Students can self-enroll and review the various resources provided, including the importance of academic integrity, examples of academic misconduct & possible sanctions, and the academic misconduct & appeal process. Students can also complete assessments to test their knowledge and earn a completion certificate.

"Integrity is doing the right thing, even when no one is watching." -- C.S. Lewis

The Faculty of Engineering expects an environment free of harassment, discrimination, and bullying. We encourage you to talk to the Office of Safe Disclosure and Human Rights about experiences, questions, or concerns. Additional resources and support for students are attached below.

Engineering students studying in the province of Alberta must also follow the Code of Ethics set by the Association of Professional Engineers and Geoscientists of Alberta (APEGA).

Course outline policies, course requirements, evaluation and grading information can be found in the University Calendar.

Safety during learning activities

In all Faculty of Engineering courses, labs, seminars or other learning activities, safety is of paramount importance. In some cases, laboratory work in a program requires high standards for risk management to keep potential hazards safely under control.

Anyone found to be unable to function safely in the class, lab, seminar or other learning activity may be asked to leave or be removed for their and the safety of other participants and instructors in alignment with the Student Academic Integrity Policy and Student Conduct Policy. As members, or prospective members, of the engineering profession, it is your responsibility to identify and inform the proper authorities of unsafe work.

Audio and video recording

Audio or video recording, digital or otherwise, of lectures, labs, seminars or any other teaching environment by students is allowed only with the prior written consent of the instructor or as a part of an approved accommodation plan.

Student or instructor content, digital or otherwise, created and/or used within the context of the course is to be used solely for personal study and is not to be used or distributed for any other purpose without prior written consent from the content author(s).

Only those items specifically authorized by the instructor may be brought into the exam facility. Students must not bring any unauthorized electronic device into an examination room, including cell phones or other devices.

Student services and support

Health & Wellness Support

Counselling and Clinical Services

Free, short-term, appointment-based counselling and psychiatric services. Also offers drop-in workshops. Book an initial consultation. Visit uab.ca/CCS to learn more.

Wellness Supports Social Workers

Free one-on-one support for students in the areas of housing, finances, academics, personal wellness, life skill development, family dynamics, system navigation, and any area of life where there is a desire to invite change. Visit uab.ca/wellness to learn more.

Sexual Assault Centre

Free, anonymous, and confidential drop-in counselling. Visit uab.ca/UASAC to learn more.

The Office of Safe Disclosure & Human Rights (OSDHR)

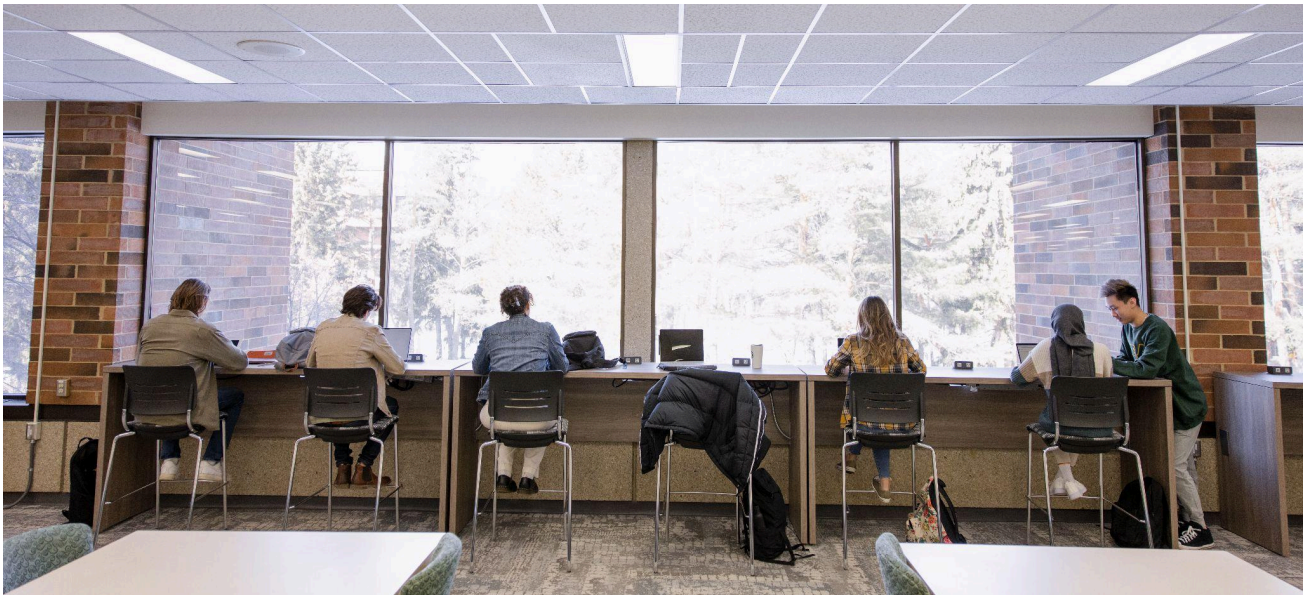
The OSDHR advises confidentially on sensitive issues you may not feel comfortable solving on your own. Contact the OSDHR if you want to get help or to make a report while keeping your privacy. Visit uab.ca/OSDHR to learn more.

HIAR (Helping Individuals at Risk)

If you're worried about someone, contact HIAR, who can help assess risk and connect individuals to support. Learn more at uab.ca/HIAR.

Immediate External Supports

Health Link Alberta: 811
Suicide Crisis Helpline: 988



Academic support

Academic Success Centre
Access to a variety of services to maximize your academic success. Learn more at uab.ca/ASC.

Accessibility Resources
Connects students with disabilities to accommodations. Learn more at uab.ca/Access under accommodations + accessibility.

Decima Robinson Support Centre
Academic support for 100- or 200-level introductory calculus, linear algebra and statistics courses. Visit uab.ca/DSC to learn more.

Engineering Student Success Centre
The Faculty of Engineering provides drop-in tutoring for first-year courses. Visit uab.ca/ESSC to learn more.

Office of the Student Ombuds
Call for complex problems and conflict mediation. Learn more at uab.ca/ombuds.

Financial support

Student Service Centre

For awards and other funding support. Learn more at uab.ca/ask.

Campus Food Bank

The Campus Food Bank Society is an independent charity supporting University of Alberta students, faculty, staff, and alumni for up to five years. For additional information visit their website at campusfoodbank.com.

Additional Help with Material

Vincent's Student Help Hours

I will be available to answer questions in my office for at least 1-hour each week. I encourage you to come by if you have questions! This time is blocked off for me to help you, so if you don't show up I'm just going to be bored… 🥱

If you are unable to attend my help hours, that doesn't mean I'm unavailable. Please send me an email and we can plan a time to chat!

Day and time: TBD – I will send out a survey.

Location: DICE 7-306 (at the far west end of the 7th floor)

Weighting of Grades

Activity	Weight
Kahoot! Participation	10%
Assignments	15%
Project "Pitch" Presentation	10%
Project Literature Summary	10%
Project Final Presentation	15%
Final Exam	40%

Kahoot!

We will hold a review quiz each week using the online quiz platform Kahoot! These quizzes are a fun (and competitive…) way to see how well you understand different concepts as we move through the course. Certain textbook sections may be assigned as "readings" throughout the course. Even though we won't cover these sections in-class, they will still be fair game on the Kahoots!

Participation in the Kahoots is worth 10% of your final grade but it doesn't matter how many questions you get right or wrong – all that matters is that you try.

Kahoot! Championship

Kahoot! scores will be tallied throughout the semester, and the person with the best score at the end of the term will have their name engraved on the Kahoot Championship Trophy! There may even be a prize for the winner (I'll keep you posted…).

Since each Kahoot! will be worth a different number of points, scores for each quiz will be normalised and taken out of a total of 10,000. The scoring formula used to calculate the championship standings after each quiz will be:

$$Championship\ Score = \frac{Participant\ Quiz\ Score}{Maximum\ Possible\ Score} \times 10{,}000$$

In order for me to easily keep track of scores, **you must use the same username in each week's quiz**. I will send you a form to register your username in the championship.

Course Project

The project for this course will be broken down into three main components. The purpose of this is to help spread the workload throughout the course. More details on the project requirements will be provided later, but a brief description of each project component is provided below.

Project "Pitch" Presentation (10% of your final grade)

You will prepare a brief (15-minute) presentation outlining your proposed course project and present it to the class. This presentation must provide the background, motivation, objectives, and proposed methodology for your project. These presentations will be given in-class in early October.

Project Literature Summary (10% of your final grade)

You will review academic literature on the topic of your course project and prepare a summary of the literature (5-pages max). This will be due before reading week.

Project Final Presentation (15% of your final grade)

You will prepare a final presentation summarising the results of your project (15-minutes). These presentations will be given in the last week of classes.

Exams

The final exam will be open-book(*ish*). Further details of what materials will be allowed for the final exam will be provided closer to the exam date.

The final exam will be scheduled by the Office of the Registrar; more information here[1]. Your personal exam schedule can be found in Bear Tracks. I will inform the class when the exam date has been determined.

The final exam will be worth 40% of your final grade.

[1] https://www.ualberta.ca/registrar/examinations/exam-schedules/index.html

Assignments

Assignments will be used as "formative" assessments. This means that the primary goal of the assignments is to help you (and me!) to *"identify misconceptions, struggles, and learning gaps… and assess how to close those gaps."* [2]

I am more interested in seeing that you have made an honest attempt to fully understand and solve the problem than whether the final answer is correct or incorrect. For this reason, assignments will be graded based on the **perceived level of effort** rather than the final answer, and we will take time to discuss any common misconceptions or errors from each assignment.

General

There will be 3-5 assignments worth 15% of your final grade.

Make sure to attempt each problem! Marks will be awarded based on the level of effort applied in solving the problem, and doing the assignments is the best way to figure out which material you understand and which you don't.

Grading Scheme

Each problem will graded based on the perceived level of effort, as follows:

Grade	Effort	Description
3	Maximum	A serious attempt has been made to provide a complete solution to the problem.
2	Moderate	Effort has been made to solve the problem, but the appearance of obstacles or misunderstandings prevented the student from obtaining a complete solution.
1	Minor	Only the early stages of the problem have been attempted.
0	None	Problem not attempted.

[2] https://poorvucenter.yale.edu/Formative-Summative-Assessments

Assignment Formatting

- Name, student ID number, assignment number, and date must appear at the top of each page.
- Assignments must be written by hand on engineering paper (or an engineering paper template).
- Digital submissions (i.e., written on a tablet) are acceptable.
- Assignments will be submitted digitally on Canvas.
- Assignments must be **neat and legible**.
- Place a box around or underline your final answer to each problem.
- **Your assignment may be returned to you ungraded if you do not follow the formatting guidelines.**

Working Together on Assignments

- I encourage you to work together on your assignments.
- You will learn from each other – one of your classmates may understand a certain concept better than you, and may explain it in a different way than I do. This can be very helpful! You will return the favour on other concepts.
- Discuss the problems in groups, but your submitted assignment **must be your own work!**
- Note: it is an academic offence to:
    - Copy all or even a portion of another person's assignment and submit it as your own.
    - Copy a homework problem solution from previous years and submit it as your own.
    - More information on Academic Integrity for Students.

AI Usage in CIV E 739

The official AI usage policy is stated on the course syllabus, but I would like to supplement that with some additional detail.

I believe that AI tools (such as ChatGPT and other large language models) can be beneficial for learning **if used properly**. In this course, it is acceptable to use AI tools to assist you with tasks such as text editing and code debugging – sort of like asking your friend "Hey, does this make sense to you? I feel like I'm missing a semicolon somewhere…"

However, **all materials submitted for grading (including assignments, reports, and presentations) must be your own work and any AI usage for editing must be openly acknowledged.** It is not acceptable to submit any work done by AI as your own work; this will be considered plagiarism. It is also critically important to verify any information that you obtain from AI to verify if it is factual or not. Some people have learned this lesson the hard way… (https://nationalpost.com/news/world/i-failed-miserably-lawyer-who-used-chatgpt-in-brief-explains-fake-cases-to-judge)

Expectations

In this class, I expect you to:

- Create a respectful learning environment.
- Actively participate in lectures and seminars.
- Don't be afraid to be wrong; answer questions!
- Please feel free to ask questions! If I haven't explained something clearly, please let me know
- Fill out the incomplete notes in class.
- Try your best to solve problems posed in class!
- Respect my time – please be attentive in class.
    - Please arrive on time.
    - If you must leave early, do so quietly.
    - PLEASE put your phones and tablets on silent (better yet, do not disturb).
    - No personal use of electronic devices.

Just as importantly, you can expect me to:

- Create a respectful learning environment.
- Be approachable and answer all questions.
- Strive to find the answers if I don't know them already (this *will* happen)!
- Respond to emails within 24 business hours.
- Modify my teaching style if required.
- Post course material on Canvas as far in advance as possible.
- Evaluate you fairly.
- Respect your time – I will not exceed our 80-minute lecture block.
- Do what I can to *help you succeed*.

How to Succeed in CIV E 739 (in my opinion…)

Lectures and Assignments

- Fill out the notes in class.
    - Completed notes will **not** be available on Canvas until 1-week after we have completed the *entire chapter*.
    - You are responsible for the course material as soon as we complete it in class.
- **Work together!**
    - I encourage you to discuss the work with each other, but submitted assignments *must be your own work!*
- Don't use the solution manual or other existing solutions!
    - The only way for you to discover what you understand and what you *don't* understand is to do the work yourself!
- Feel free to ask for help – that's what I'm here for!

Exams

- Use your time *efficiently*.
- Draw neat sketches.
- Double-check your calculations.
- **Read all problems at the beginning so you know where to begin and how much time to allocate!**
- Have your calculator, pencil, ruler, eraser, *and* spares.
- Running out of time? Briefly explain in words how you would have solved the problem!

Detailed Course Outline

These are the textbook chapters and topics that we will aim to cover during the course. The course material might vary slightly as the course progresses.

Chapter 1: Basic Concepts (1-2 lectures)

- Flow classification
- Velocity Distribution
- Pressure distribution

Chapter 2: Steady Flow Conservation Laws (2 lectures)

- Conservation of mass, momentum, and energy
- Equation of motion
- Specific energy

Chapter 3: Critical Flow (2 lectures)

- Rectangular and non-rectangular channels
- Application of critical flow
- Computation of critical flow depth

Chapter 4: Uniform Flow (1-2 lectures)

- Flow resistance
- Computation of normal depth
- Compound channel cross-sections

Chapter 5: Gradually Varied Flow (1-2 lectures)

- Governing equations
- Classification of water surface profiles
- Sketching of water surface profiles

Chapter 6: Computation of Gradually Varied Flow (2 lectures)

- Direct-step method
- Standard-step method
- Integration of differential equation
- Guest lecture: developing a 1D model in HEC-RAS

Chapter 7: Rapidly Varied Flow (4-6 lectures)

- Application of conservation laws
- Supercritical flow
- Weirs
- Hydraulic jumps
- Spillways and energy dissipators

Chapter 10: Steady Flow Special Topics (1 lecture)

- Flow through culverts
- Flow measurement
- Velocity measurements

Chapter 11: Unsteady Flow and **Chapter 18: Unsteady Flow Special Topics** (2-3 lectures)

- Occurrence of unsteady Flow
- Height and celerity of a gravity wave
- Rating curves
- Flood routing

Chapter 12: Governing Equations for One-Dimensional Flow (1 lecture)

- St. Venant equations
- Boussinesq equations