CIV E 681 Seepage and Drainage

Winter 2024 - January 08 to April 12

Class time: Monday, Wednesday 9:30-10:50 Location: NRE 2-122

Instructor:

Nicholas Beier, PhD, P.Eng
(780)492-8183
nabeier@ualberta.ca
DICE 6-224
Office Hours: by appointment

Course Description:

*4 (fi) (first term, 3-1S-1) Elements of hydrogeology; regional groundwater flow, borehole logging methods. Theory of groundwater flow through soils and rocks, permeability, Darcy's law, field governing equations and their solution by approximate methods, finite difference and finite element methods, unsaturated flow. Civil engineering applications, seepage in earth structures, design of dewatering systems for excavations and slopes, field testing, grouting

Course synchronous and asynchronous content delivery schedule:

Lectures will be mainly synchronous. Some lectures may be provided by guest lecturers (subject matter experts or TA) in either synchronous or asynchronous format. In the case of instructor absence, recorded lecture material will be made available on eClass for asynchronous consumption.

Course Objectives & General Content:

The course objectives are to investigate the nature of groundwater flow (GWF) in subsurface soils and rocks and the impacts on engineering projects and the environment.

Learning Outcomes:

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

1. • Understand the nature of groundwater flow
2. • Analyze and quantify seepage through porous media.
3. • Design for the influence of seepage on engineering projects.
4. • Design seepage control methods.
5. • Understand seepage in rocks and contaminant transport

Marking Scheme:

Activity	(A)Synchronous	Due/Scheduled	Weight
Assignment 1	Asynchronous		5%
Assignment 2	Asynchronous		5%
Assignment 3	Asynchronous		5%
Laboratory Report (group submission)	Asynchronous		10%
Quiz 1	Synchronous	February 5, 2024	22.5%
Quiz 2	Synchronous	Marach 11, 2024	22.5%
Final exam	Synchronous	See Beartracks	30%

The Faculty recommended grade point average for a 600 level course is 3.3. 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

Only approved non-programmable calculators are permitted in examinations. Any calculator taken into an examination must have a sticker identifying it as an acceptable non-programmable calculator (gold sticker). Students can purchase calculators at the University Bookstore with the stickers already affixed. Calculators purchased elsewhere can be brought to the Student Services where the appropriate sticker will be affixed to the calculator.

Text and References (Mandatory):

No single required text book

Text and References (Recommended):

Cedergren (1989) Seepage, Drainage, and Flow Nets
Harr (1962) Groundwater and Seepage
Freeze and Cherry (1979) Groundwater
Cashman and Preene (2020) Groundwater Lowering in Construction
Cushman and Tartakocsky (2017) Handbook of Groundwater Engineering, 3rd Edition.
Supplementary References (see list/sources on eclass)
Lecture notes – provided on eclass

Website:

eClass

Previous Examples of Evaluative Materials:

to be provided on eclass

Lab Information:

Lab Topic	Date
Lab 1: Lab 1 - Permeability	2024-01-17
Lab 2: Lab 2 - Seepage in model dam	2024-01-31

Students will undergo lab specific safety training as a part of this course and are expected to follow appropriate lab safety procedures at all times.

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!

Course Topics (subject to revision based on progress)

Lecture	Chapter
	1) Introduction
	2) Elements of Hydrogeology and Regional groundwater flow
	3) Fundamentals of Groundwater Flow (GWF) Darcy's law Hydraulic conductivity and its determination Effects of water chemistry on permeability Empirical equations of permeability
	4) 2D GWF Equations and Solution Methods Governing equations for saturated and unsaturated flow Flow net technique Soil anisotropy and layering Method of Fragments Finite different method Finite element method
	5) Water Pressure and Seepage failure Effect of seepage on water pressure Effect of seepage on lateral earth pressure Effect of seepage on slope stability Seepage failure
	6) Well Hydraulics Unidirectional flow: unconfined or confined aquifer Radial flow to wells: unconfined or confined aquifer Multiple well systems Methods for dewatering excavation
	7) Pumping tests In-situ pumping tests of k Piezometers: Types, response time, time lag
	8) Seepage Control in Dams Methods of control: filters, drainage and seepage reduction Dam cross-sections for seepage control Filters design for prevention of piping failures Geotextiles for drainage Seepage reduction using cut-offs
	9) Groundwater Flow and Contamination Groundwater quality Sources of contamination Contaminant migration in groundwater Equations for solute transport in GW

26	10) Flow through Rock Rock fractures GWF in fractured rock mass Permeability of rock and discontinuities Groundwater instrumentation in rocks

Problem Assignments

Assignments and the laboratory requirements will be posted the eClass site. The lab report will be group submission (conducted in groups of 3-4 as approved by the course instructor). Completed assignments and group lab report must be submitted electronically prior to 5:00 pm on the due date identified for each assignment. Late assignments will not be marked, unless permission to submit it late is obtained in advance.

Laboratory Schedule

Lab #1 – January 17, 2-5 PM

Lab #2 – January 31, 2-5 PM

UNIVERSITY AND FACULTY POLICIES

COURSE OUTLINE POLICY

The policy about course outlines can be found in Course Requirements, Evaluation Procedures and Grading of the University Calendar, see https://calendar.ualberta.ca/

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. University is an opportunity for students to explore areas of interest and to potentially pursue a career in a specific field. The Faculty of Engineering prepares students to uphold industry standards to become a Professional Engineer (P. Eng). Respect, professionalism, and accountability must be upheld within the Faculty of Engineering.

Harassment and discrimination are serious issues that have a negative effect on culture and therefore the Student Conduct Policy states that no student shall discriminate against or harass any person or group of persons. The Faculty expects an environment free of harassment, discrimination, and bullying. Please refer to the Definitions for Discrimination, Accommodation and Harassment.

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, due to intoxication, harassment or discriminatory behaviour, or other reasons, 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 Code of Behaviour or Student Conduct Policy. As members, or prospective members, of the engineering profession, it is your responsibility to identify and inform the proper authorities of an unsafe work/learning environment.

AUDIO/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. The use of unauthorized personal listening, communication, recording, photographic and/or computational devices is strictly prohibited. Students should refrain from bringing any unauthorized electronic device into an examination room, including cell phones, high tech watches, high tech glasses or other such devices.

ACADEMIC INTEGRITY

Students at the University of Alberta must follow, in its entirety, the **Code of Student Behavior.** Failure to know the Code is not an acceptable excuse for breaking the Code.

If you have not already done so, make sure you review the Code, which is found here along with other resources: https://www.ualberta.ca/natural-applied-sciences/portfolio/education/academic-integrity-and-discipline.html

Engineering students studying in the province of Alberta should also follow the **Code of Ethics** by The Association of Professional Engineers and Geoscientists of Alberta (APEGA), which is found here: https://www.apega.ca/members/legal-obligations

The Code of Student Behavior should not be too hard to follow. Listen to your instructor, be a good person, and do your own work, as this will lead you toward a path to success. Failure to follow the Code can result in a grade of 'F' for the course, a transcript remark, suspension, and even expulsion from the university.

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

Engineering at Alberta

NEED HELP?

There are a lot of services available to students on campus and in Edmonton, and sometimes it's hard to know where to go. While this isn't a comprehensive list, the services shown here should at least give you some ideas about where to start. If you're still not sure, check out the services just beneath this box—they'll give you the guidance you're looking for.

DON'T KNOW WHERE TO GO?

Student Service Centre

The U of A's central hub to find the right help for your needs.
uab.ca/ask

24/7 HELP

Empower Me (international)
1-833-628-5589

Edmonton Distress Line
780-482-4357 (HELP)

WELLNESS

Wellness Supports
Free 1:1 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.
P: 780-492-1619 | E: wellness@ualberta.ca
M-F, 8:30am-4:30pm (Sep-April), 8:00am-4:00pm (May-Aug)

Counselling and Clinical Services
Free, short-term, appointment-based counselling and psychiatric services. Also offers drop-in workshops. Book an initial consultation.
P: 780-492-5205 | M, R, F, 8:00am-4:00pm; T, W, 8:00am-7:00pm

Interfaith Chaplains' Association
Get guidance, care, and support, whether or not you identify with a particular faith. Make an appointment.
P: 780-492-0339 | E: interfaithchaplains@ualberta.ca

The Landing
Offers drop-in support on matters of gender and sexual diversity.
P: 780-492-4949 | E: thelanding@su.ualberta.ca | M-R, hours vary

Peer Support Centre
Anonymous, confidential help from trained students. By appointment only.
P:780-492-4268 | E: psc@su.ualberta.ca | M-F, 9:00am-8:00pm

Sexual Assault Centre
Free, anonymous, and confidential drop-in counselling.
P: 780-492-9771 | E: sexualassaultcentre@ualberta.ca
M-F, 9:00am-8:00pm

University Health Centre
An on-campus health clinic that provides medical services to staff, students, and their spouses and children.
P: 780-492-2612 | E: hws@ualberta.ca | M-F, 8:30am-4:00pm

ACADEMIC

Engineering Student Services
Drop-in, first-come, first-served advising.
E: enggadvising@ualberta.ca

Engineering Student Success Centre
Drop-in tutoring for first-year courses.
E: dessc@ualberta.ca

Academic Success Centre
Many services to maximize your academic success. E: success@ualberta.ca | M-F, 8:30am-4:30pm

Academic Accommodations
Connects students with disabilities to accommodations. E: arrec@ualberta.ca
M-F, 8:30am-4:30pm

Office of the Student Ombuds
Call for complex problems and conflict mediation.
P: 780-492-4689 | E: ombuds@ualberta.ca

FINANCIAL

Student Service Centre
For awards and other funding supports.
uab.ca/ask

Campus Food Bank
Many food support options available. E: info@campusfoodbank.com

SOCIAL

Unitea
Arrange a time to socialize with a peer.
E: unitea@ualberta.ca

BearsDen
U of A webpage. Find student groups, local events, and volunteer opportunities.

WORRIED ABOUT SOMEONE?

Helping Individuals at Risk (HIAR)
If you're worried about someone because of the things they've been saying or doing, or there's a noticeable change in their behaviour (often in multiple ways), contact HIAR, who will protect your confidentiality and help decide how best to support the person.

780-492-4372
hiarua@ualberta.ca

CONFIDENTIAL SUPPORT

Office of Safe Disclosure and Human Rights

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.

780-492-7357
osdhr@ualberta.ca