



Carleton
UNIVERSITY
Department of Earth Sciences

Course outline

ERTH 3205 Physical Hydrogeology Winter 2023

Course Description

This course introduces hydrogeology and the interaction between surface water, groundwater, and earth materials in the subsurface. Course topics include the water/hydrologic cycle, aquifer types, properties of groundwater, principles of groundwater flow, wells and well testing, and water balance, and groundwater resource evaluation. The course will also cover the geology and geophysics of groundwater and discuss the tools used for groundwater exploration and evaluation. The topics will be taught through series of lectures and laboratory studies

Course delivery: Course delivery is in-person lectures and laboratory assignments, will be held on Mondays in HP 3120 and HP2130 respectively.

PURPOSE AND OBJECTIVES: This course is an introductory examination of the physical principles of groundwater flow through the subsurface. It builds on the student's basic knowledge of bedrock and surficial geology and introduces how fluids can exist within and flow through earth materials. Students will also learn how to quantify and measure groundwater flow, to determine potential groundwater yields, and manage groundwater as a resource

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Course Format, requirements, and policies.

The class will consist of two hours lecture and three hours laboratory work every week. Both lectures and labs will be held **in-person** in Herzberg 3120 and **Laboratories exercise held in HP 2130**. Lecture notes and other course materials will be posted on Brightspace ahead of the class. Attendance at lectures and labs is mandatory. Students who enrolled in this course are required to attend lectures and labs every week, read ahead of lectures, and submit lab work and assignment at scheduled time. It is the students' responsibility to refer regularly to the course website for lecture material, reading assignment, announcements, due dates, and other important information. Attendance in class and lab is in-person and mandatory and weight toward 5%. It is required that you email the instructor to advise of your absences due to illness or emergencies before lecture and within **two days** of missing an assignment deadline or an exam. **Assessment will comprise assignments, laboratory exercises, midterm exam, and final examination.**

Assignment and Lab work: The **assignments** will be a combination of theoretical problems and practical applications. **There will be 3 lab assignments/lab tasks, one per month, in January, February, and March.** They will be posted on Brightspace, and students will be required to submit through the assignment module in Brightspace. Submission will not be accepted by email, except otherwise stated. The lab will be a mixture of demonstrations, theoretical problems (to aid firm understanding of the topics), and manual/computer-based approaches to data analyses and interpretation. Students are expected to complete laboratory tasks within the laboratory hours and submit at the end of the lab. Students will use geophysics software available in the lab and other programs such as excel and MATLAB to complete assignments where necessary. Carleton students can download MATLAB to their own computers for free by following the instructions at this website: <https://carleton.ca/its/all-services/computers/site-licensed-software/matlab-students/>

Final Exam will be on mathematical problems and long answer questions, take place **in-person digital within the formally scheduled final exam period.**

Midterm: There will be a midterm exam at the end of February (27th February) and it will be based on the topics already covered in lectures and labs. For all labs, assignments and exams, *always* show your full working steps for mathematical problems and describe the terms and notations to attract full mark. Full mark will not be awarded if the logic and workflow of the answer is not very clear. Some words describing the mathematical steps can be very helpful. Make sure to properly highlight your final answer to each problem.

Participation in class discussion will be noted and counts as **part of 5%**. Participation has nothing to do with being the most correct, or the most profound. It's about encouraging students to ask questions, make comments, and to think out loud about what they are reading and learning.

Missed Deadlines

If you foresee you might miss a deadline, you must inform the professor before the deadline. If you miss the deadline for a task or exam due to unforeseen circumstances, then you must contact the course professor within 2 days of the deadline and provide appropriate documentation in order to obtain an extension. Where accommodation is not granted, **missed deadline attracts 5 marks deduction per day up to a maximum of 25 marks.** [Submissions not received with two weeks will not graded and the student will be awarded a zero except they got accommodation.](#) The late policy for this class is designed to be fair to students who hand their

work in on time. Late submission will not be graded after the assignment grades and feedback are returned to the remainder of the class.

Email policy: All questions relating to this course should be sent to the Brightspace discussion board, not my email, to allow other students benefit from the question and responses. The TA and I will respond to questions on 'discussion board within 24 hours, except on weekends. Given the number of students on this course and the professor's workload, students are encouraged to use discussion board for all questions on the course and only email the professor when they are to discuss personal and confidential matters.

Grading Scheme

Laboratory exercises and assignments -	30%
Midterm exam	25%
Final Exam – in-person Schedule	40%
Lecture attendance and participation –	5%
Total –	100%

SCHEDULE: Lecture topics will focus on the physical hydrogeology topics described above and below. Laboratory assignments are designed to reinforce the theoretical material covered in the lectures by providing practical problems. These assignments will be split between field-oriented exercises and problem sets.

Lecture: Mondays 8:35 - 10:25 @ HP 3120
Laboratory: Mondays 11:35 – 14:25 @ HP 2130

Week #	Lecture date	Lecture Topic	Lab activity
1	Jan 9	Meeting and Introductory lecture, water cycle	No lab
2	Jan 16	Physical properties and principles of groundwater flow	No lab
3	Jan 23	Physical properties and principles of groundwater flow	Lab 1 TBC
4	Feb 30	Physical properties and principles of groundwater flow	Lab 2 TBC
5	Feb 6	Physical properties and principles of groundwater flow	Lab 3 TBC
6	Feb 13	Groundwater Geology	Lab 4 TBC
7	Feb 22-24	Winter Break	Winter Break
8	Feb 27	Midterm exam Groundwater Geophysics and exploration	Midterm Exam
9	Mar 6	Groundwater Geophysics and exploration	Lab 5 TBC
10	Mar 13	Groundwater resource evaluation and case histories	Lab 6 TBC
11	Mar 20	Groundwater resource evaluation and case histories	Lab 7 TBC
12	Mar 27	Groundwater resource evaluation and case histories	Lab 8 TBC
13	Apr 3	Exam review	Exam review

14	Apr 10	Exam review	Exam review
15	Apr 12 -	Exam period	Exam Period

*Above schedule is subject to slight modifications

Suggested References:

There is no mandatory textbook for this course however, I recommend the following: 1. Freeze, R.A. and Cherry, J.A., 1979, Groundwater, Prentice Hall.
 2. Fetter CW. 2001. Applied hydrogeology. 4th ed. Upper Saddle River (NJ): Prentice- Hall.
 3. Domenico, P. A. and Schwartz, F. W., 1998. Physical and Chemical Hydrogeology, 2nd Edition, John Wiley and Sons.

Handbooks:

Driscoll, F.G., 1986. Groundwater and Wells, Second edition. Published by Johnson Division, St. Paul, Minnesota.
 Kruseman, G.P. and de Ridder, N.A., 1990. Analysis and Evaluation of Pumping Test Data. International Institute for Land Reclamation and Improvement, Netherlands. **Journals**
 Groundwater (Journal of the National Groundwater Association)
 Hydrogeology Journal (Official Journal of the International Association of Hydrogeologists)

Academic Integrity

It is your responsibility to review Carleton's policy on Academic Integrity - Section 14 of the Calendar.

<http://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/acadregsuniv14/>

Plagiarism

Any work submitted by a student must be their own and credit must be given to work of others, images or texts, consulted or used in one's write-up. Students must clearly attribute any quotations or copied figures (citing name(s) of author(s) + year + publication of the work and the web link as the case may be). It is not EVER permitted to copy another student's work. If a student is found to be in violation of copy right policy, there will be very serious consequences. Instructors are required to report all incidents (or suspected incidents) of plagiarism to the Dean.

The instructor is required to report all incidents (or suspected incidents) of plagiarism to the Dean. **All work handed in must be your own.** Plagiarism and cheating are viewed as being particularly serious and the sanctions imposed are accordingly severe. Students are expected to familiarize themselves with and follow the Carleton University Student Academic Integrity Policy. The Policy is strictly enforced and is binding on all students. Plagiarism and cheating – presenting another's ideas, arguments, words, or images as your own, using unauthorized material, misrepresentation, fabricating or misrepresenting research data, unauthorized cooperation or collaboration or completing work for another students – weaken the quality of the graduate degree. Academic dishonesty in any form will not be tolerated. Students who infringe the Policy may be subject to one of several penalties including: expulsion; suspension from all studies at Carleton; suspension from full-time studies; a refusal of permission to continue or to

register in a specific degree program; academic probation; or a grade of failure in the course.

Requests for academic accommodation

Please review the Carleton's Student Guide to Academic Accommodations at

<http://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf>, and the websites therein.

For Students with Disabilities:

"The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical

conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your **Letter of Accommodation** at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation. After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website (www.carleton.ca/pmc) for the deadline to request accommodations for the formally-scheduled exam.

For religious observance:

1. As soon as you receive your course syllabus, identify any potential conflicts between your religious obligations and course requirements. 2. Make a formal written request to your instructor indicating the nature of the religious obligation and suggest possible alternative dates and/or means of satisfying the academic requirements. NOTE: Such request should be made during the first two weeks of the term, or as soon as possible after a need for accommodation is known to exist, but in no case later than the second last week of classes for that term. For detailed information on Religious Obligations please visit our website at: carleton.ca/equity/accommodation/academic.

For pregnancy:

A. For final exams, identify and discuss your needs for final examinations with your professors. When an agreement is reached fill out and submit the online **Pregnancy Accommodation Final Exam Request Form** at: carleton.ca/equity/accommodation. Equity Services will forward the request to Exam Services to coordinate the accommodation. **B.** For in-class accommodations ONLY. If you anticipate you will only require in-class accommodations, discuss them directly with your course instructor. This request should be made in the first two weeks of the academic term. For detailed information on pregnancy and parental leave policies please visit the website

at: carleton.ca/equity/accommodation/academic/

Equity and PMC Contact information:

- Department of Equity and Inclusive Communities, 613-520-5622, 3800 Carleton Technology & Training Centre, equity@carleton.ca Website: carleton.ca/equity
- Paul Menton Centre for Students with Disabilities 613-520-6608 pmc@carleton.ca 500 University Centre. Website: carleton.ca/pmc

Statement on Student Mental Health

As a university student you may experience a range of mental health challenges that significantly impact your academic success and overall well-being. If you need help, please speak to someone. There are numerous resources available both on- and off-campus to support you. Here is a list that may be helpful:

Emergency Resources (on and off campus): <https://carleton.ca/health/emergencies-and-crisis/emergency-numbers/>

Carleton Resources:

- Mental Health and Wellbeing: <https://carleton.ca/wellness/>
- Health & Counselling Services: <https://carleton.ca/health/>
- Paul Menton Centre: <https://carleton.ca/pmc/>
- Academic Advising Centre (AAC): <https://carleton.ca/academicadvising/>
- Centre for Student Academic Support (CSAS): <https://carleton.ca/csas/>
- Equity & Inclusivity Communities: <https://carleton.ca/equity/>

Off Campus Resources:

- Distress Centre of Ottawa and Region: (613) 238-3311 or TEXT: 343-306-5550, <https://www.dcottawa.on.ca/>
- Mental Health Crisis Service: (613) 722-6914, 1-866-996-0991, <http://www.crisisline.ca/>
- Empower Me: 1-844-741-6389, <https://students.carleton.ca/services/empower-me-counselling-services/>
- Good2Talk: 1-866-925-5454, <https://good2talk.ca/>
- The Walk-In Counselling Clinic: <https://walkincounselling.com>