

University of Colorado Denver
Department of Civil Engineering
CVEN-5334 Groundwater Hydrology

Fall 2019 Rev. 1

Lecture: Monday/Wednesday 5:00 – 6:15 pm

Location: Plaza Building 112

Office Hours: Monday/Wednesday 3:30 – 4:45 pm

→ or by appointment

Instructor: David C. Mays, P.E., Ph.D.

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<http://www.ucdenver.edu/dmays/5334>

Catalog Description: Topics include groundwater occurrence, hydrologic cycle and budget, interactions with surface waters, principles of groundwater flow, well hydraulics, well field design, regional flow systems, water and pollutant chemistry, computer modeling and groundwater management. Emphasis is on quantitative analysis methods for groundwater resource inventory, design and management.

Prerequisites: Graduate standing in civil engineering or consent of instructor. Basic proficiency is assumed in fluid mechanics, differential equations, and spreadsheet applications like Microsoft Excel.

Course Objectives: At the end of the semester, you should be able to:

1. Draw a figure illustrating the major reservoirs and fluxes in the hydrologic cycle.
2. Using Darcy's law, calculate groundwater flows in natural formations and approaching wells.
3. Calculate the elastic behavior of soils (swelling and compression) using effective stress.
4. Analyze transport of dissolved contaminants in saturated media, and design for cleanup.
5. Derive the differential equations for water balance, groundwater head, and contaminant transport from differential control volumes, and then apply these relationships to engineering problems.

Required Text: Fitts, C.R. (2013), *Groundwater Science*, 2nd edition, Boston, Academic Press, ISBN 978-0-1-2384705-8. A bound hard copy is required for the open-book midterms and final exams.

Week	Dates	Topic	Reading and Video Assignments*
1	8/19, 8/21	hydrologic cycle	1.1-1.7, Taylor (1966)
2	8/26, 8/28	Darcy's law (LAB #1)	2.1-2.2, 2.5-2.6, 3.1-3.2, 3.4
3	9/4	potential flow	7.4, Finnemore and Franzini (2002) 14.1-14.8
4	9/9, 9/11	aquifer properties	2.4, 3.3, 3.5-3.9, 4.1-4.2.2, 4.2.5-4.2.6, 5.1-5.6
5	9/16, 9/18	aquifer mechanics	6.1-6.5, 6.7-6.8
6	9/23, 9/25	aquifer flow (EXAM #1)	6.9-6.9.2, 7.1-7.2.1, 7.2.3-7.2.5, 7.3, 7.5-7.5.1
7	9/30, 10/2	modeling	6.10, 9.1-9.2, 9.6
8	10/7, 10/9	MODFLOW (LAB #2)	Simcore (2019) 1.1-1.4
9	10/14, 10/16	well hydraulics I	7.2.2, 7.2.6-7.2.10, 7.5.2
10	10/21, 10/23	well hydraulics II	8.1-8.6, Miller et al. (2007)
11	10/28, 10/30	contaminants I (EXAM #2)	10.1-10.4.1, 10.5.2, 10.9.2
12	11/4, 11/6	contaminants II	11.1-11.3, 11.5-11.7, Simcore (2019) 1.6-1.8
13	11/11, 11/13	groundwater remediation	11.8-11.9
14	11/18, 11/20	heterogeneity (LAB #3)	
15	12/2, 12/4	Colorado groundwater	Topper et al. (2003) 3, 6.1

* Please visit the course website for these supplemental reading and video assignments by Finnemore and Franzini (2002), Miller et al. (2007), Simcore (2019), Taylor (1966), and Topper et al. (2003).

Midterms: Wednesday 9/25/2019 (weeks 1-4), [Monday 10/21/2019 \(weeks 1-8\)](#).

Final Exam: [Monday 12/9/2019, 5:00-7:00 pm, Plaza Building 112.](#)

Grades: 20% homework, 20% each midterm, 35% final exam, 5% participation.

Homework

Homework will be assigned in class each Monday or through the “Assignments and Answers” link on the course website, and will be due in class Wednesday of the next week. Engineering paper is strongly encouraged but not required. I reserve the right to return homework for re-write and re-submit if it is (1) illegible, or (2) does not comply with the following standards:

1. At the top of *each* page, write your name, class number, homework number, due date, and page of total. For example, for a 5-page submission, the first page is 1 of 5, the second 2 of 5.
→ *If you are submitting late, also write the date submitted on the first page.*
2. Draw a picture for *each* problem. Use a straight edge for straight lines.
3. Briefly restate *each* problem in your own words. Do not copy the problem statement verbatim.
4. State what you are going to calculate under heading FIND.
5. State any relevant assumptions, including assumed precision of input numbers.
6. Indicate the units for all numbers, not just final results, except for dimensionless ratios.
 - a. *Please write 5 ft rather than 5' and 8 in rather than 8''.*
 - b. *Units like psi are fine for results, but use lb/in² to show unit cancellation in work.*
 - c. *Use the same units (metric or US) as the problem statement.*
7. Write each result, with the correct number of significant digits, on its own line.

These standards will help you establish the professional habit of producing clear calculations in compliance with given requirements. You will produce a set of documents that you may reference down the road for your FE exam or PE exam or both. These standards will also simplify grading, which means you get your homework back faster, and they keep the grader happy—which is always a good thing. Homework grades are A (100%), B (85%), C (75%), D (65%), and F (0%). Homework will be graded for correctness, approach, and presentation. To earn an A, you must clearly and correctly calculate all the problems while fully complying with the standards.

- Late homework will be penalized by 10% per class (except by 15% from A→B). However, no credit will be granted for assignments whose solutions have been posted online.
- Late homework not stating the date submitted will be penalized by one letter grade.
- Unstapled homework (with more than one sheet of paper) will be penalized by one letter grade.
- Except by prior arrangement, homework submitted electronically or any time outside office hours or class will be penalized by one letter grade.

Participation

Rationale for participation grade: Learning is an activity that we perform (like dancing, fixing cars, or skiing) rather than a commodity that we purchase. I will attempt to call on each of you each week. You are expected to reply every time. Why? Because you are training to become a professional, who will be called upon to speak up and answer technical questions. People will expect you to be prepared. This means you should complete the reading assignment before class. If you make a habit of missing class, your participation grade will suffer.

Communication

You are required to check your official university e-mail account at least once every 24 hours during business days, or arrange to have your e-mail from this account forwarded to another e-mail account that you check at least once every 24 hours during business days. For details, see the university website.*

Academic Integrity

This course will comply with the *2019-2020 Undergraduate Catalog* or *2019-2020 Graduate Catalog*, including the Academic Integrity and Discipline Policies,[†] and with the Student Honor Code for the College of Engineering, Design and Computing. You must perform and present your own work. Studying with others may be useful, but copying assignments—from a solutions manual, from other students, from a paid tutor, or from any other source—or cheating on exams will not be tolerated. Midterm and final exams will be governed by an Exam Policy to be distributed separately. Importantly, to avoid plagiarism, cite your sources using American Society of Civil Engineers format.[‡]

General

- Snow Closure Hotline 877-556-3637.
- I am happy to work with students needing special accommodations. The university asks students to register with Disability Resources and Services (DRS), who then evaluate each situation on a case-by-case basis. I will provide accommodations per the official letter I receive from DRS.
- Missed exams will receive an F, except (a) when special arrangements have been made with me ahead of time, or (b) with documentation of a medical emergency.
- Unclaimed homework, reports and exams will be destroyed on or after 2/1/2020.
- Grades will not include plus or minus designations.
- Syllabus subject to revision.
- Students are responsible for all material presented in lecture, readings, homework, and communicated by e-mail.

Finally, this semester's Academic Calendar and our Student Honor Code are attached below. If you have not done so already, please sign the Student Honor Code and return it to the department office.

Welcome to the class!

* <http://www.ucdenver.edu/email/Pages/Email-Resources.aspx>

† <http://catalog.ucdenver.edu/content.php?catoid=26&navoid=7846>

‡ <http://ascelibrary.org/doi/pdf/10.1061/9780784478998.ch17>

MONTH	DAY	DEADLINE	IMPORTANT NOTES
APRIL	1	➤ First day to apply for Fall Graduation via UCDAccess.	
	1-16	➤ Registration begins for Fall Semester via UCDAccess. Check UCDAccess for your specific registration date and time assignment.	❖ For best course selection, register as soon as possible after your registration time assignment.
AUGUST	19	➤ First day of Fall semester classes	
	25	➤ Last day to add or WAITLIST classes using UCDAccess. ➤ Last day to request or cancel Grade Forgiveness	❖ Refer to the Grade Forgiveness Form for restrictions.
	26	➤ Last day to drop a class without a \$100 drop charge. ➤ First day to add classes with the Late Add Form with instructor approval	❖ All waitlists will be eliminated today.
SEPTEMBER	2	➤ Labor Day Holiday	❖ No classes. Campus closed.
	4	➤ CENSUS DATE – until 5:00 PM. ➤ Last day to DROP full term classes with a financial adjustment. ➤ Last day to ADD full term classes with instructor approval on a Late Add Form ➤ Last day to request No Credit or Pass/Fail grade for a class. ➤ Last day to apply for Fall graduation via UCDAccess. After this date, contact your advisor.	❖ After this date, dropped classes will appear on your transcript with a grade of 'W'. ❖ After this date, you will be charged the full tuition amount for additional classes added – College Opportunity Fund hours will not be deducted from eligible student's lifetime hours.
		27	➤ Last day to WITHDRAW from a class via UCD Access
OCTOBER	28	➤ First day to WITHDRAW from a class with a required authority signature on a Late Withdraw Petition Form	
NOVEMBER	25-1	➤ Fall Break Begins – Nov. 25 through Dec. 1	❖ No classes. Campus open.
	28	➤ Thanksgiving Day Holiday.	❖ No classes. Campus closed.
DECEMBER	4	➤ Last day to WITHDRAW from a class with a required authority signature on a Late Withdraw Petition Form	
	9-14	➤ Finals week.	
	14	➤ End of semester – Commencement.	
	19	➤ Final grades available on UCDAccess and transcripts (tentative).	
	25-1	➤ Winter Break – Dec. 25, 2019 through Jan.1, 2020	❖ No classes. Campus closed.
JANUARY	24	➤ Fall degrees posted on UCDAccess and transcripts (tentative).	❖ This is the date your degree will be recorded on your transcript; diplomas begin mailing on February 12th.

[➤ Refer to the Residency website for important deadlines pertaining to In-State Tuition Rate qualification. \(www.ucdenver.edu/residency\)](#)

[➤ Refer to the College Opportunity Fund \(COF\) website for important deadlines pertaining to the COF stipend for eligible undergraduate students paying in-state tuition. \(www.ucdenver.edu/cof\)](#)

Additional Billing/Financial Information: Students are responsible for complying with tuition/fees deadlines. All registered students must access their student account and billing information through UCDAccess. You will also receive an electronic bill to your university email account.

Intensive, module, and off-cycle classes require the same amount of work and number of classroom hours as full-term classes. Intensive classes are less than five weeks. Module classes last five or more weeks, but less than full term. Off-cycle classes vary in length. Module/intensive classes may be added up until the first day of the class. After the first day of class, these classes may be added with the instructor's signature approval and a Schedule Adjustment form is required to drop these classes. Instructor approval is not required to drop the class within the first 15% of class meetings.

Spring 2020 (tentative)	Jan. 20	Martin Luther King Jr. Holiday	No classes. Campus Open.
	Jan. 21	Classes begin	
	Mar 23- Mar 29	Spring Break	No classes. Campus Open.
	May 16	End of semester - Commencement	
Maymester 2020 (tentative)	May 18	Maymester classes begin	
	May 25	Memorial Day Holiday	No classes. Campus Closed.
	June 4	Maymester classes end	
Summer 2020 (tentative)	Jun 8	Summer classes begin	
	July 4	Independence Day Holiday	No classes. Campus Closed.
	Aug 1	End of semester	



Student Honor Code

The Honor Code outlined below is the College of Engineering and Applied Science statement on academic integrity. The Code articulates the College's expectations of its students and faculty in establishing and maintaining the highest standards in academic work.

Honor Code Text

The Honor Code of the College of Engineering and Applied Science is a statement of its students, individually and collectively:

- Students will not give or receive aid during examinations.
- Students will not use any prohibited electronic devices during examinations.
- Students will not give or receive unpermitted aid in class work, in the preparation of reports, or in any other work that is to be used by the instructor as the basis of grading.
- Students will uphold the spirit and letter of the Honor Code and they will take an active role to ensure that others uphold the Honor Code and if they observe violations of the Honor Code they must report violations to their Department Chair.
- The Faculty of the College will do its part to ensure its confidence in the honor of its students. Faculty must ensure that precautions are in place to prevent the forms of dishonesty mentioned above. Faculty will also avoid, as far as practical, academic procedures that create temptations to violate the Honor Code. Faculty alone has the right and obligation to set academic requirements. However, the students and faculty will work together to establish optimal conditions for honorable academic work.

Violations of the Honor Code

Examples of conduct that will be regarded as being in violation of the Honor Code include:

- Copying from another's examination paper or allowing another to copy from one's own paper.
- Plagiarism in any shape or form. Plagiarism is defined as the use, without giving reasonable and appropriate credit to or acknowledging the author or source, of another person's original work, whether such work is made up of code, formulas, ideas, language, research, strategies, writing or other form(s).
- Giving or receiving unpermitted aid either in person or via electronic devices.
- Engaging in unauthorized collaboration on academic assignments or examinations.
- Representing as one's own work the work of another.

Penalties for Violating the Honor Code

Most student disciplinary cases have involved Honor Code violations. Of these, most cases arise when a student submits another's work as his or her own, gives or receives unpermitted aid, or engages in unauthorized collaboration. If a violation occurs during a quiz or on a homework assignment, the student will receive a zero for that quiz or assignment. If a violation occurs on an examination, the student will receive a failing grade for the course. The standard penalty for a first offense may include suspension from the College of Engineering and Applied Science for a severe infraction of the Honor Code. The penalty for a second violation will be expulsion from the College of Engineering and Applied Science.

It is the responsibility of the student to seek clarification from the instructor when in doubt about these guidelines.

By signing below, I affirm that I have read and understood the Student Honor Code and will abide by its provisions.

Student Signature

Date