

CE 4363/5363 is a hybrid course, allowing up to 23 students in the CE 205 classroom with masks, social distancing, and tabletop sanitizing. All lectures will be recorded to the Mediasite for live synchronous streaming or later viewing or the recordings. Dr. Rainwater will poll the students to see which ones prefer face to face or online. If more than 23 prefer face to face, a rotation schedule will be set up to allow those students to be in the classroom for as many lectures as possible.

Potential for Course Modality Change

If Texas Tech University campus operations are required to change because of health concerns related to the COVID-19 pandemic, it is possible that this course will move to a fully online delivery format. Should that be necessary, students will likely need a webcam and microphone and will be advised of additional technical and/or equipment requirements, including remote proctoring software. Students must have access to a PC-type laptop that meets the laptop requirements

<https://www.depts.ttu.edu/coe/dean/engineeringitservices/buyingtherightcomputer.php> as stated by the Whitacre College of Engineering.

Illness-Based Absence Policy

If at any time during this semester you feel ill, in the interest of your own health and safety as well as the health and safety of your instructors and classmates, you are encouraged not to attend face-to-face class meetings or events. Please review the steps outlined below that you should follow to ensure your absence for illness will be excused. These steps also apply to not participating in synchronous online class meetings if you feel too ill to do so and missing specified assignment due dates in asynchronous online classes because of illness.

1. If you are ill and think the symptoms might be COVID-19-related:

- a) Call Student Health Services at 806.743.2848 or your health care provider.
- b) Self-report as soon as possible using the ttucovid19.ttu.edu management system. This website has specific directions about how to upload documentation from a medical provider and what will happen if your illness renders you unable to participate in classes for more than one week.
- c) If your illness is determined to be COVID-19-related, remaining documentation and communication will be handled through the Office of the Dean of Students, including notification to your instructors.
- d) If your illness is determined not to be COVID-19-related, please follow steps 2.a-d below.

2. If you are ill and can attribute your symptoms to something other than COVID-19:

- a) If your illness renders you unable to attend face-to-face classes, participate in synchronous online classes, or miss specified assignment due dates in asynchronous online classes, you are encouraged to visit with either Student Health Services at 806.743.2848 or your health care provider. Note that Student Health Services and your own and other health care providers may arrange virtual visits.
- b) During the health provider visit, request a "return to school" note;
- c) E-mail the instructor a picture of that note;
- d) Return to class by the next class period after the date indicated on your note.

Following the steps outlined above helps to keep your instructors informed about your absences and ensures your absence or missing an assignment due date because of illness will be marked excused. You will still be responsible to complete within a week of returning to class any assignments, quizzes, or exams you miss because of illness.

Covid-19 Policies and Procedures in Engineering Buildings

1. All people entering an Engineering Building must **wear a mask and maintain social distances (6 ft)** at all times
2. **Do not enter any Engineering Building** until 3 minutes before your class is scheduled to begin, and you must **enter through a designated door** (exception for ADA compliance) and maintain social distancing (see signs on exterior doors to identify entrance and exit doors)
3. **Leave through a designated door.** Signage will indicate traffic directions; you are required to follow that signage (except in the case of a fire or emergency, leave from the closest door)
4. **All classrooms have assigned seating** and students are to sit in the same seat every class, as well as wipe off their seat, desk, and equipment (wipes provided) when they enter each classroom, and prior to leaving each classroom
5. **No eating or drinking** in any common areas or the classrooms, and no loitering in buildings
6. **Stay 9 ft from the instructor(s)**
7. Students will be **dismissed row by row starting immediately at the class scheduled ending time.** That gives 10 mins to clear the room.
8. **In case of inclement weather** (e.g., rain or snow) students can form orderly lines, in the buildings, while maintaining the proper 6 ft distancing right up to the classroom door

Breaking any of these rules may result in your class being delayed or canceled!

CE 205 Seating Chart for Face to Face Students

[illegible]

- Enter the Civil Engineering building from the double doors on the east or west sides.
- Come up the central stairs to CE 205, come in the south door, and find a seat.
- Sign the signature page and include your seat number.
- Leave the room as directed through the north door.
- Go around the hall to the right then go down the north stairs and leave the building by the exit door on the northeast corner of the building.
- If you have another class in the CE building, repeat the cycle above.

CE 4363/5363 Groundwater Hydrology Spring 2021

Meetings: 3:00-4:20, MW, CE 205.

Instructor: Ken Rainwater, Ph.D., P.E., 834-7775, office CE 117.

Office hours: 9:00-11:00 and 1:00-2:00 MW, or by appointment.

Text: *Applied Hydrogeology*, 4th ed., by C. W. Fetter. Other materials to be distributed.

Course Schedule (may be adjusted by instructor as appropriate)

Class	Dates	Topics and Events
1	Jan 20	Ch. 1, Water
2	Jan 25	Ch. 3, Properties of Aquifers – Porosity, Hydraulic Conductivity
3	Jan 27	Ch. 3, Storage, Head, Compressibility
4	Feb 1	Ch. 4, Principles of Groundwater Flow – Darcy's Law
5	Feb 3	Ch. 4, Basic Groundwater Flow Equations
6	Feb 8	Ch. 4, 1-D Flow Solutions
7	Feb 10	Ch. 5, Groundwater Flow to Wells – Unsteady
8	Feb 15	Ch. 5, Steady Flow Solutions
9	Feb 17	Ch. 5, Pump Test Analyses
10	Feb 22	Ch. 5, Well Interference, Superposition, Recovery Test
11	Feb 24	Ch. 5, Slug Tests, Partial Penetration, Well Losses
12	Mar 1	Ch. 13, Groundwater Models, MODFLOW introduction
13	Mar 3	Assign Project , MODFLOW continued
14	Mar 8	Midterm Exam (Chs. 1, 3-5)
15	Mar 10	Ch. 7, Regional Groundwater Flow
16	Mar 15	Ch. 6, Soil Moisture and Recharge
17	Mar 17	Ch. 12, Field Methods
	Mar 19	Spring Break
18	Mar 22	Water Well Construction (not in text)
19	Mar 24	Water Well Construction (not in text) continued
20	Mar 29	Ch. 9, Water Chemistry
21	Mar 31	Ch. 9, Equilibrium Solutions
	Apr 5	Day of No Classes
22	Apr 7	Project Due , Ch. 9, Redox, Ion Exchange
23	Apr 12	Ch. 9, Isotopes
24	Apr 14	Ch. 10, Water Quality and GW Contamination
25	Apr 19	Ch. 10, 1-D Contaminant Transport
26	Apr 21	Ch. 10, Capture Zones
27	Apr 26	Ch. 11, GW Development and Management
28	Apr 28	Ch. 11, Water Law, Firm Yield
29	May 3	Review

Final Exam: Monday, May 10, 4:30 p.m.-7:00 p.m.

Course Objectives

The student will learn the skills and theory required to investigate and analyze the occurrence and movement of groundwater in the subsurface using analytical and numerical tools. The student will also learn field methods and selected water quality topics.

Course Policy

1. Homework – There will be six to eight homework assignments scattered through the course, usually with two class days (or one week) between assignment and due date allowed for completion. **There is no late policy.** Solutions should include brief problem statements and outline the solution approach leading to a well-labeled answer. Work on one side of the paper only. Illegible homework will be returned ungraded. Computer applications will be used on some assignments. Students are expected to be computer literate. **When spreadsheets are used, sample calculations are required, and each student must turn in his/her own result, with his/her name printed on each spreadsheet page from within Excel.**

2. Project – There will be one individual modeling project during the middle of the semester using **PC software called Groundwater Vistas as a pre- and post-processor for MODFLOW.** Students will need to be able to run the software on their own computer, as the College does not provide it in the computer labs. Apple users must have Apple's Boot Camp (free) or other associated software to provide a Windows environment on their Macs to make the PC software work.

3. Exams – Two exams, one at midterm and one during the final period, will be given. **No make-up exams will be given for simple absence.** If a student has an emergency conflict with any assignment, prior notice must be given to the instructor.

4. Article Review (those enrolled in CE 5363) – See separate handout.

Distinction Between CE 4363 and CE 5363

The graduate students will be expected to answer additional questions on the two exams and to write one brief review of an article from the refereed literature. The graduate students and undergraduate students will be each be graded relative to their peers.

Grading Policy

	CE 4363	CE 5363
Homework	25%	20%
Two Exams	50%	50%
Project	25%	20%
Review		10%
	100%	100%

Religious Holidays

"Religious holy day" means a holy day observed by a religion whose places of worship are exempt from property taxation under Texas Tax Code §11.20. A student who intends to observe a religious holy day should make that intention known in writing to the instructor prior to the absence. A student who is absent from classes for the observance of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence. A student who is excused under section 2 may not be penalized for the absence; however, the instructor may respond appropriately if the student fails to complete the assignment satisfactorily.

Academic Dishonesty

Academic integrity is taking responsibility for one's own class and/or course work, being individually accountable, and demonstrating intellectual honesty and ethical behavior. Academic integrity is a personal choice to abide by the standards of intellectual honesty and responsibility. Because education is a shared effort to achieve learning through the exchange of ideas, students, faculty, and staff have the collective responsibility to build mutual trust and respect. Ethical behavior and independent thought are essential for the highest level of academic achievement, which then must be measured. Academic achievement includes scholarship, teaching, and learning, all of which are shared endeavors. Grades are a device used to quantify the successful accumulation of knowledge through learning. Adhering to the standards of academic integrity ensures grades are earned honestly. Academic integrity is the foundation upon which students, faculty, and staff build their educational and professional careers. ***If you don't cheat, we'll be fine.***

Course Outcomes

This course provides the conceptual framework, mathematical tools, and modern software techniques to insure the students' proficiency in engineering problems associated with use of groundwater resources, addressing the objectives of both degree programs.

• **ABET BSCE Student Learning Outcomes**

- (1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics (application of Darcy's law, well hydraulics, aquifer characterization, equilibrium water chemistry, and computer modeling of groundwater flow)
- (2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors (design of a well field with the constraints of minimizing drawdown and approximate optimization of capital and pumping costs)
- (7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies (MODFLOW application)

• **ABET Program Specific Outcomes**

Civil Engineering

- proficiency in water resources engineering (description of aquifers, well hydraulics, groundwater modeling)
- design a system, component, or process in more than one civil engineering context (design of a well field)

Environmental Engineering

- introductory level knowledge of environmental issues associated with air, land, and water systems and associated environmental health impact (issues of groundwater quantity and quality)
- an ability to perform engineering design by means of design experiences integrated throughout the professional component of the curriculum (design of a well field with the constraints of minimizing drawdown and optimization of capital and pumping costs)

Disability Policy

Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor's office hours. Please note: instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, please contact Student Disability Services in West Hall or call 806-742-2405.

CEE Departmental Calculator Policy for Exams

Only NCEES approved calculators will be permitted during tests, and your test will be collected and your grade will be a zero if you are caught using a non-approved calculator. The approved calculators include the following:

- Casio: All fx-115 and fx-991 models (Any Casio calculator must have "fx-115" or "fx-991" in its model name.)
- Hewlett Packard: The HP 33s and HP 35s models, but no others
- Texas Instruments: All TI-30X and TI-36X models (Any TI calculator must have "TI-30X" or "TI-36X" in its model name.)

Laptops/PDAs/MP3 Players/Cell Phones/etc.

The use of laptops, phones, and MP3 players is not permitted during lectures or exams without consent of the instructor. While discussions of software applications are presented in class, you are normally expected to do your own applications with your own computer outside of class. This approach will be apparent as the course progresses. The instructor will be available in office hours and beyond for your questions.