Colorado State University
Department of Civil and Environmental Engineering
Fall 2016
CIVE 531 – Groundwater Hydrology

Instructor: Dr. Ryan Bailey
Email: rtbailey@engr.colostate.edu
Office phone: 491-5045
Office location: Engineering A207-A
Office hours: MWF 11:00 – 12:00

Class Time: T-Th 8:00 – 9:15 am
Class Location: Scott Bioengineering 229

Class Website: http://info.canvas.colostate.edu/login.aspx/ The Canvas website will be used to post homework assignments, additional instructional material, announcements, etc.

Textbook: There is no required text for this course. Lecture material and homework problems will be taken from a variety of sources (textbooks, software programs, technical reports, etc.). Some excellent reference textbooks are:

- *Groundwater* (Freeze and Cherry)
- *Applied Hydrogeology* (Fetter)
- *Groundwater Hydrology* (Todd and Mays)
- *Groundwater Science* (Fitts)
- *Fundamentals of Ground Water* (Schwartz and Zhang)

Prerequisites: CIVE 300 or CBE 331 or WR 416

Course Description: Development of groundwater resources; origin, movement, distribution of subsurface water; groundwater modeling; groundwater quality and contaminant transport modeling; remediation.

Objectives: Familiarize students with concepts, terminology, chemistry, and math skills required to solve basic groundwater problems.

Topics Covered:

- Overview of groundwater distribution and use (historical and current)
- Storage and transmission of groundwater
- Groundwater interaction with surrounding environment
- Analytical and Numerical Modeling
- Estimating aquifer parameters

- Groundwater quality and remediation
- Groundwater system design
- Vadose Zone Hydrology

Teaching Philosophy: The successful completion of this course requires your attention, hard work, and respect. In return, I will strive to create a classroom setting that encourages learning, critical thinking, and respect for all students. I will endeavor to meet your academic needs, and as such encourage all students to take advantage of the weekly office hours. **I enjoy helping students outside of the classroom**. However, please be respectful of my time, as I have other duties to perform within the department.

I teach mainly with board notes, with PowerPoint slides used occasionally to assist with visualizing the physical problem.

Academic Integrity: Academic dishonesty is extremely serious. University rules, including academic penalty and further investigation by the university authorities, will be strictly enforced in this course. Please review the CSU Student Code for details regarding these rules. I know that solution manuals are available for most textbooks on the internet. Copying from them not only will prevent you from learning, and thereby result in lower exam scores, but also may lead to dismissal from the course.

Reading: You will be assigned 4-5 journal papers as reading material throughout the semester. These are chosen to enhance the material covered in lecture. There will be a short 5-10 minute quiz regarding the material of the paper at the beginning of the next lecture.

Homework:

- Homework sets will be assigned most weeks, due at the start of class on the date indicated on the assignment sheet. Late homework will be accepted, although the score will be decreased by 25% of the total possible points for each day that the assignment is late.
- Homework assignments must be typed or neatly hand-written on engineering paper. Solution development shall be shown in a step-by-step manner. Partial credit will be given. Students can collaborate on homework sets but each student must write and submit their own homework. Copying is not allowed!
- See attached sheet for formatting guidelines (points will be taken off for failing to meet these guidelines)

Field Labs:

- There will be several field labs during the semester. The location of these is yet to be determined. Field labs will consist of monitoring well drilling, water table level reading, and groundwater sampling. More information (timing, logistics) will be provided as the semester progresses.

Exams:

- Exams consist of two mid-term exams. These will be closed book, with 1 sheet (front and back) of notes and equations.
- Exams will consist of both non-quantitative (i.e. short answer) and quantitative sections, and will cover material from lectures, homework, and field labs.
- The only calculator models acceptable for use during exams are Casio fx-115 models, HP 33s and 35s, TI-30X and TI-36X models.

Makeup exam policy: For students who cannot attend regular exams due to university business duty, serious illness, or family emergency (all with written proof), a makeup exam may be arranged AFTER the regular exam. The instructor must be notified prior to the exam, and no exceptions will be made without a legitimate reason and a timely arrangement.

Modeling Projects: There will be 2 modeling projects assigned during the semester: These will focus on analytical and numerical modeling. A brief report will be submitted documenting the modeling process and presenting results.

Course Grading:
The grading breakdown is as follows:

- Reading Quizzes 5%
- Field Lab (attendance) 5%
- Homework 25%
- Mid-Term Modeling Project 15%
- Mid-Term Exam #1 15%
- Mid-Term Exam #2 15%
- Final Modeling Project 20%

Term grades for this course will use the ± grading system as described in the CSU catalog. Grades will be assigned according to the following range:

90 – 100%	A
80 – 89%	B
70 – 79%	C
60 – 69%	D
< 60%	F

<u>This range will not be shifted up</u>. However, it may be shifted down based on relative difficulty of homework exercises and exams. If, at the end of the semester, a student's score is 0.5% from a higher grade, then that student will receive the higher grade ***<u>if</u>*** the student's semester homework score is <u>higher</u> than the student's overall semester score.

Tentative Lecture Schedule

Date	Day		Topic Details	Software	HW
8/23/2016	Tue		Introduction to Course / Groundwater Overview		
8/25/2015	Thu		Hydrologic Balance / Geologic Framework		HW 1
8/30/2016	Tue	Basic	Groundwater Energy		
9/1/2016	Thu	Theory	Groundwater Storage		HW 2
9/6/2016	Tue		Field Lab: Monitoring Well Installation		
9/8/2015	Thu		Groundwater Transmission		
9/13/2016	Tue	Flow	Groundwater Modeling - Flow Equation		
9/15/2016	Thu	Equation	Vadose Zone Hydrology - Flow Equation		HW 3
9/20/2016	Tue		Groundwater Modeling - Analytical - 1D/2D applications		
9/22/2016	Thu		Groundwater Modeling - Analytical - Flow to Wells		
9/27/2016	Tue	Analytical	Groundwater Modeling - Analytical - Flow to Wells		HW 4
9/29/2016	Thu	Modeling	**Exam #1**	Wellz	
10/4/2016	Tue		Groundwater Modeling - Superposition		**Proj. #1**
10/6/2016	Thu		Groundwater Modeling - Glover Solution		HW 5
10/11/2016	Tue		Groundwater Flow: Numerical Modeling	Spreadsheet	
10/13/2016	Thu	Numerical	**Work on Modeling Project**		
10/18/2016	Tue	Modeling	Groundwater Flow: Numerical Modeling	MODFLOW	
10/20/2016	Thu		Groundwater Flow: Numerical Modeling	ModelMuse	
10/25/2016	Tue	Pumping	Finding and Developing Groundwater		
10/27/2016	Thu		Pumping Wells: Design and Performance		HW 6
11/1/2016	Tue		Groundwater Chemistry, Contamination, Transport		
11/3/2016	Thu		Contaminant Transport Modeling - Analytical		
11/8/2016	Tue		Contaminant Transport Modeling - Numerical	MT3D	**Proj. #2**
11/10/2016	Thu	Chemical	**Exam #2**		
11/15/2016	Tue	Transport	**No Class**		
11/17/2016	Thu		Isopotes and Groundwater Age Dating		HW 7
11/22/2016	Tue		**FALL BREAK**		
11/24/2016	Thu				
11/29/2016	Tue		Estimating Aquifer Parameters		
12/1/2016	Thu		Estimating Aquifer Parameters		HW 8
12/6/2016	Tue		Groundwater Remediation: Site Assessment/Cleanup		
12/8/2016	Thu		**Finish Final Project**		
12/14/2015	**Mon**		**Final Exam 6:20-8:20 pm**		