CE 40460
Groundwater Hydrology

Fall Semester, 2018

Instructor: Diogo Bolster
120C Cushing Hall
631-0965
dbolster@nd.edu

Office Hours: Any time my door is open and I truly mean that. If homework is due, I will make sure to be in my office on the afternoon (2-4:30) of the preceding day.

Welcome to CE 40460! I hope that this course is rewarding to you and that you develop an appreciation for groundwater hydrology through your experiences here. The course aims to have a balance between theory and practice. I am always learning how to be a better teacher, so continuing feeback is **desired** and **encouraged**. Lets make this a great course together. My goals for this course are broadly speaking

1. Introduce you to the basic concepts and techniques used in groundwater hydrology
2. Use current events, local hydrology and lab demos to help you learn these concepts
3. Help you to develop skills in approaching complex problems where there may not be a single 'correct' answer or approach. Guesstimation and educated judgement are strongly encouraged and will be rewarded.
4. Encourage you to THINK, OBSERVE, and ANALYZE
5. Provide you with experience in approaching the decision making processes involved in a real engineering applications.
6. Provide you with the opportunity to work within a team environment.

The primary means by which we will work together towards these goals are:

1. Lectures: I am looking for ACTIVE participation by each of you in the learning process,
2. Case studies: Active analysis of case studies,
3. Assignments: Significant effort on your part in completing assignments, and
4. Field Studies: An active, "hands-on" laboratory.

Please note that I DO expect you to be able to program at leaset minimally (in MATLAB, EXCEL or any other programming language of your choice.)

As with all courses at Notre Dame, this course is covered by the Honor Code.

Topics we will cover in this class

The schedule listed below is approximate and subject to changes. If you have suggestions or interests, LET ME KNOW and I will try to work them in!

In Class

Hydrology and Hydrogeology – What are they and why do we care?
The Hydrological Cycle
Basic Properties of Aquifers/ Porous Media
Darcy's Law
The Flow Equation: Initial Conditions, Boundary Conditions, Uncertianty
Sources of Data
Field Measurements
Heterogeneity of Aquifers
Flow to Wells
Building Conceptual and Numerical Models
Water Quality and Ground Water Contamination
Advection, Advection and Dispersion
Chemical Reactions (Retardation)
Multiphase Flow (Unsaturated Flow/Vadose Zone
Variable Density Flow

Visiting Guest Lecturers talking about real life projects

Labs (Tuesdays 2-4, but not every Tuesday)

Field – surveying, depth to water tests, slug tests, water quality (at least one field session each – preliminary dates are Sep 11, 18, 25 and/or Oct 2).
Computer – Building numerical models to study groundwater flow and transport (2-3 sessions with in class excercises).

Your responsibilities

Homework – approximately one homework per topic that we will cover (typically about 6).
Exams – 3 exams, two midterms (provisionally around Oct 9/11 and Nov 13/15, but this is by no means fixed as the pace of the class depends on you) and one final.

This is a 4 credit class; the extra credit relates to two things, a field trip where we actually measure groundwater related metrics in a real field site and an essay on a topic of your choosing that relates to groundwater Your obligations here are

- Final Report on Field Work (Due just before Thanksgiving, although there will be increments to it as we learn different topics)
- An essay on a topic of your choosing (Due last day of semester)

Grading

I am assuming that your primary motivation for being here is your desire to learn the maximum you can from this course. If this is not correct, we should immediately discuss whether this course is for you!

There is no absolute grade scale for this course. The class will be graded both individually and collectively. On a class basis, all students in the course this semester will be judged by the general level of effort of the class as a whole. If the class portrays a relatively lazy attitude with memorization being the primary motivation, the average grade within this course will be lower. If, on the other hand, the class shows a spirit for the pursuit of knowledge, the average grade will be relatively high.

How does one demonstrate this spirit? First, the leaders among the students must truly have this spirit. This spirit (or lack thereof) is quite obvious from the questions asked during (and outside of) lectures, the level of interaction in class, the level of effort in the projects, and the level of effort in forming active study groups outside of class. Second, the students must demonstrate more interest in learning how to think like engineers than in receiving credit for a particular answer or minimizing the amount of effort placed in a homework assignment. This is not to say that you should not provide feedback as to whether problems are beyond your understanding. I STRONGLY ENCOURAGE ACTIVE FEEDBACK ON ALL PHASES OF THIS COURSE. Further, it is your responsibility (as well as mine) to make sure that your fellow students are getting the most from this course. If that requires challenging me to teach better, DO SO. If that requires challenging each other to work harder, DO SO. If that requires challenging yourself to become more involved, DO SO.

On an individual basis, students will receive points as listed below. How the points received will translate into grades will depend on the level of effort of the class as a whole.

Total Points= 200

- Exams = 100 points (25 for each midterm and 50 for final)
- Projects Grade = 50 points (25 +25)
- Homework = 30 points
- In class participation = 20 points (And this is real)