

**CE 40460**  
**GROUNDWATER HYDROLOGY**

Fall Semester, 2016  
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Office Hours: Thursday after class or by appointment or any time my dorr is open

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 feedback 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, Uncertainty

Sources of Data

Field Measurements

Uncertainty

Heterogeneity of Aquifers

Flow to Wells

Building Conceptual and Numerical Models

Water Quality and Ground Water Contamination

Advection, Advection and Dispersion

Numerical Approaches to Advection Dispersion

Chemical Reactions (Retardation)

Wellhead Protection and Management

Vadose Zone

Variable Density Flow

Climate Change and Groundwater

Visiting Guest Lecturers talking about real life projects

#### **Labs**

Field – surveying, depth to water tests, slug tests, water quality ( at least one field session)

Computer – Building numerical models to study groundwater flow and transport (3)

#### **Your responsibilities**

Homework – approximately one homework per topic that we will cover.

Exams – 3 exams , two midterms 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 a group project on building a regional groundwater model. Your obligations here are

Final Report on Field Work

Final Report on Groundwater Hydrology Model

## 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 = 60 points (40 +20)

Homework+Assignments = 20 points

In class participation = 20 points