PHYSICAL HYDROGEOLOGY, 51-365/565 (3 credits)
FALL 2005

Class Hours: 12:40 - 2:50 p.m WF

Location: Harrington 217

Instructor: Dr. Maureen Muldoon
Office: Harrington 104
Phone: 424-4461
Email: muldoon@uwosh.edu
Web: http://www.uwosh.edu/faculty_staff/muldoon/

Office Hours:
Monday 10:20 - 12:30
Wed, Fri 10:20 - 11:20
3:00 - 5:00
Or by appointment

Required Texts: *Applied Hydrogeology*, C.W. Fetter, 4th edition, Prentice Hall, Inc., 2001
A Civil Action, Jonathan Harr, 1995, Vintage Books (paperback)

Supplemental Texts:
Basic Ground-Water Hydrology, Ralph Heath, 1980, U.S. Geological Survey, Water-Supply Paper 2200
Fundamentals of Ground Water, F.W. Schwartz and H. Zhang, John Wiley & Sons, 2003

Course Web Page:

I have developed a D2l site for this course. You must login to the D2L system. The easiest way to get into D2L is as follows:

- go to UW-Oshkosh's home page (http://www.uwosh.edu/),
- click on the "Current Students" button (right side of page),
- Go to the "Technology" section (left side of page),
- click on "Desire2Learn" and
- follow the instructions on the login page.

When you log in you will see general D2L announcements, a calendar (lower left), and a list of your D2L courses (you need to click on the course name to enter a specific course). Within the Physical Hydrogeology course, there is a navigation bar above the announcement area that contains the following tabs: Course Home, Content, Quizzes, Grades, and Classlist. The course calendar can also be accessed through the schedule link at the very top of the page (above the course name). The site contains lecture outlines and PowerPoint files, schedule of lectures, lecture outlines and reading review questions

Course Description & Goals:

The purpose of this course is to develop a sound understanding of the various aspects of the hydrologic cycle, with the major emphasis on groundwater hydrology. The first third of the course provides an overview of the hydrologic cycle, surface water hydrology, and water budgets. The second two-thirds of the course emphasizes aquifers properties, principles of groundwater flow, flow in the unsaturated zone, well hydraulics and regional groundwater flow systems. In addition to covering the above topics; this course is designed to give you experience in manipulating, analyzing and presenting hydrogeologic data.

Prerequisites:

The study of groundwater differs from some other areas of geology in that we can rarely observe groundwater or the processes that control groundwater flow. Therefore, we must use the principles of physics (and chemistry) to describe and predict the behavior of groundwater. This means that the course will be quantitative in nature. College Algebra and Trigonometry (67-108) are a prerequisite for this course and I will assume that everyone is comfortable with problem-solving involving algebra, unit conversions, graphing, and calculators.

Expectations:

Attendance and Participation:

There is a good deal of research that suggests that students learn better when they can discuss and analyze the concepts presented to them as part of a group. I've modified this course to decrease the time I spend lecturing and to include more in-class activities and exercises. In order for you to get the most out of this class, it is crucial that you attend each class session and that you have completed the reading assignment *prior* to class. The required reading assignments are listed in the following course schedule. To help focus your reading, I will post "reading review questions" for each day's topic on the course web page. You should prepare written answers to these questions *before* coming to class. At least once a week, I will collect your answers and use them as the basis of the "quiz" portion of your final grade. I also expect participation in class; I will be asking many questions to assess your understanding of the material and I hope that you will be asking me questions as well.

Assignments:

The assignments (in-class exercises, problem sets and labs) are critical to helping you gain an understanding of the material covered. The labs are designed to reinforce the material covered in lecture as well as give you "hands-on" experience in manipulating and interpreting hydrologic data. The problem sets will provide you with practice in solving quantitative problems. All problem sets and labs are due on the specified due date. Late assignments will not be accepted unless there are extenuating circumstance and prior arrangements have been made.

Evaluation:

Exams: There will be three hour exams. If you need to miss a scheduled exam (for some valid reason such as illness), you must inform me prior to the exam (by phone or email). A make-up exam must be taken as soon as possible at a time convenient for us both.

Laboratory: A report will be due for each lab exercise. The level of report will vary from exercises turned in at the end of class, short written reports, and some lab exercises will require that you work in groups and present your results to the rest of the class in a brief presentation. The due date for each lab will be announced when the lab is given out.

Problems: Approximately four problem sets will be assigned during the semester. Solutions (including all work and assumptions) must be written neatly. Problem sets can be turned in during class or placed in my mailbox by 5:00 pm on the due date. Any assignment submitted after that time will be considered late, unless arrangements have been made for an excused late submittal. Late work will be penalized 10% for each day that it is late.

Outside Reading:

Over the course of the semester, you are expected to read Jonathan Harr's *A Civil Action,* a well-written account of an actual groundwater contamination case in Woburn, MA. Many of your lab exercises will be based on data from the Woburn area. You should keep a "journal" while reading the book. As you read, note the pages where you come across information that you feel will be pertinent in the groundwater contamination case. This will serve to focus your reading and help you develop an index to the places in the book that contain pertinent hydrogeologic data.

It is acceptable to work together on lab write-ups and problem assignments, however, it is not acceptable to copy a fellow student's work. Each student will be responsible for the material covered in these exercises and must be able to present his/her work.

Grades:

15%	Exam 1
15%	Exam 2
15%	Exam 3
20%	Labs
20%	Problem sets
15%	Class Participation/quizzes

Scale

92 - 100%	= A	72 - 76.9%	= C
87 - 91.9%	= AB	67 - 71.9%	= CD
82 - 86.9%	= B	62 - 66.9%	= D
77 - 81.9%	= BC	<62%	= F

The final letter grade will be assigned based on the above scale, unless the class average deviates significantly from 75%. In the latter case, a "curve" will be applied.

TENTATIVE SCHEDULE

Week		Topic	Reading	Assignments
Part 1: Hydrologic Cycle and Water Budgets				
1	9/7	Intro/What is Hydrogeology **Lab:** Quantitative Problems	1.2, 1.6-1.12 (skim)	bring an example of a budget to class on Friday
	9/9	Water/Water Budgets **Lab:** Woburn Introduction Spreadsheets/Climatic Data	1.3 - 1.5	Chapter 1 PS Assigned
2	9/14	Evaporation/Transpiration **Lab:** Web exploration; PS help	2.1-2.3	
	9/16	Precipitation/Infiltration/Soil Moisture **Lab:** ET Calculation	2.4 - 2.8	Chapter 1 PS due
3	9/21	Stream flow Stream/GW interaction **Lab:** Basin Delineation/Format of water resources reports	2.9 - 2.10, 2.13	
	9/23	Analysis of Streamflow Data **Lab:** Grapher Introduction/analysis of stream data	2.11-2.12, 2.14	
4	**Part 2: Porosity & Permeability**			
	9/28	Porosity/Specific Yield **Lab:** Porosity/Grain-size	3.1-3.3	
	9/30	Stream Data Presentations Work on reports		
5	10/5	Geologic Controls on Porosity/ Permeability	S&Z pg 13-32	Woburn Report 1 due
	10/7	**EXAM 1** – chapters 1, 2, & part 3		
Part 3: Groundwater Flow				
6	10/12	Darcy's law & Hydraulic Head **Lab:** Sank Tank Model	3.4.1, 4.1-4.4	
	10/14	Force Potential & Darcy's Law **Lab:** Permeability/Field Measure of Head	4.5-4.6	PS 2 Assigned

7	10/19	Hydraulic Conductivity/Heterogeneity **Lab:** Woburn Geologic Setting	3.4-3.5, 3.11 8.2 to pg 291	
	10/21	Aquifers/Aquifer Characteristics (T, S)	3.7, 3.9-3.10	
8	10/26	Mapping Hydraulic Head/Gradients **Lab:** Woburn Geologic Setting	3.6, 3.8, 3.12	
	10/28	Granular vs. Fractured Media	D&S pg 48-51	PS 2 due
9	11/2	*No Class*		
	11/4	Groundwater Flow Equations **Lab:** Woburn Water Table	4.7	
10	11/9	**Lab:** Woburn Water Table		
	11/11	Solutions to GW Flow Equations **Lab:** Exam Review	4.8, 4.13 - 4.14	Woburn Report 2 due
11	11/16	**Exam 2**		
	11/18	Flow Nets **Lab:** Flow Nets (by hand)	4.9 - 4.12	
12	11/23 & 25	Thanksgiving Break – No Class		
13	11/30	Aquifer Tests— response of an ideal well to pumping **Lab:** Flow Nets (with computer)	5.1-5.5	PS 3 Assigned
	12/2	Single-well tests Aquifer Tests --non-ideal wells **Lab:** Aquifer Test Analysis (PS 3)	5.6-5.7 5.8-5.9	
14	12/7	Unsaturated Zone Flow	6.1-6.7	PS 3 due
	12/9	Regional GW Flow -topographic driving force GW/SW Interaction	7.1-7.3 7.7	
15	12/14	Review/Catch Up		
	12/16	**Exam 3**		