

**51-366/566 Chemical Hydrogeology (3 credits)
Spring 2008 Syllabus**

Instructor: Dr. Maureen Muldoon

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Office Hours:

Tues: 11:30 - 12:30

4:10 - 5:10

Wed: 10:20-12:30

Thurs: 10:20 - 12:30

Class Time: Tuesday & Thursday 1:50-4:00, Harrington 217

Required Text:

Fundamentals of Ground Water, F.W. Schwartz and H. Zhang, John Wiley & Sons, 2003

Supplemental Texts:

Applied Hydrogeology, C.W. Fetter, Fourth edition, Prentice Hall, Inc., 2001

Physical and Chemical Hydrogeology, P.A. Domenico and F.W. Schwartz, 2nd Ed., John Wiley & Sons, 1998

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:

- Type the following web address into your browser (<http://www.uwosh.edu/d2l/>),
- follow the instructions on the login page.

Course Description & Goals:

This is a survey course with the overall goal of providing the theoretical and practical background necessary to address groundwater contamination problems. The first portion of the course will emphasize the chemistry of natural waters and the important reactions affecting groundwater chemistry. The second portion of the course will cover the physical and chemical processes affecting solute transport and provide an introduction to the characteristics of common contaminants. The final portion of the course will provide an overview of basics of site characterization procedures and methods of remediating soil and groundwater contaminants.

Many folks pursuing the "Hydrogeology Professional Emphasis" do so in the hope of obtaining employment in the environmental consulting field. To be successful in either the job market or graduate school you will need both a strong theoretical background in hydrogeology as well as many specific skills. My goals for this course are that you 1) gain a good understanding of basic principles of groundwater chemistry and contaminant transport; 2) develop adequate quantitative skills; 3) be able to manipulate and analyze both hydrogeologic and geochemical data; and 4) develop adequate communication skills so that you can prepare technical reports and presentations.

Prerequisites:

The study of contaminant hydrogeology requires not only a background in geology, but also a familiarity with the fields of physics and chemistry. The prerequisites for this course include Physical Hydrogeology (51-365) and General Chemistry II (32-106). Many portions of this course will be quantitative in their emphasis; it is only by applying mathematics, physics, and chemistry that we can provide answers to questions such as How fast does groundwater flow? How far will a certain contaminant travel? How will contaminant concentrations change over time?

Expectations:*What I expect from you:*

- to take responsibility for your own learning
- to come prepared for class and be an enthusiastic participant in class
- to set high standards for work in group settings and in individual assignments
- to behave in an ethical manner

What you can expect from me:

- to be enthusiastic and knowledgeable about the course material
- to create a challenging course
- to treat you with fairness and respect
- to set high standard for the class

Attendance and Participation:

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 topic on the D2L site. You should prepare written answers to these questions *before* coming to class.

Assignments:

The assignments 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 hydrogeologic and geochemical 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 (see schedule below). Late assignments will not be accepted unless there are extenuating circumstance and prior arrangements have been made.

Evaluation:

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

Laboratory: Laboratory sessions will be a mix of case studies, demonstrations, and laboratory & field exercises that will require a written report. The level of report will vary from exercises turned in at the end of class to short written reports. The due date for each lab will be announced when the lab is assigned.

Problems: Three problem sets (approximately 30 to 40 points each) will be assigned during the semester; the due date for each problem set is included in the following course schedule. Solutions (including all work and assumptions) must be written neatly.

It is acceptable to work collaboratively on lab write-ups, problem sets, and reading review questions. It is not acceptable to directly copy work from your colleagues and turn it in as your own. This constitutes a violation of the UW-O Student Discipline Code.

Grades:		Scale			
15%	Exam 1	>92%	= A	72 - 77%	= C
15%	Exam 2	87 - 92%	= AB	67 - 72%	= CD
15%	Exam 3	82 - 87%	= B	62 - 67%	= D
25%	Lab write-ups	77 - 82%	= BC	<62%	= F
20%	Problem sets				
10%	Quizzes and class participation				

The final letter grade in this course 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.

Special Needs:

Any students who need special accommodations for learning or who have special needs are invited to share these concerns or requests with the instructor as soon as possible.

TENTATIVE SCHEDULE

The following tentative schedule outlines the topics and assignments for each day. I expect that there will be revisions to the schedule as the semester progresses especially in the lab portion of the course. I will announce any changes/revisions in class and post them on the D2L site.

****Readings:** S&Z = Schwartz & Zhang, F=Fetter, D&S=Domenico & Schwartz; reading in [brackets] is not required but is recommended if you feel that you need further clarification on some topic.

Week		Topic	Reading**	Assignments
1	2/5	Course Overview/Review of Hydro Basics <i>Lab: Site Characterization I-Hydrostratigraphy</i>		
I. Groundwater Chemistry				
	2/7	Dissolved Constituents in GW <i>Lab: Woburn Hydrostratigraphy</i>	S&Z 16.1-16.3 [F 9.1-9.3, 9.13]	Writing Exercise
2	2/12	Chemical Equilibrium <i>Lab: Site Characterization I-Hydrostratigraphy</i>	S&Z 17.1-17.3, [F 9.4-9.6]	
	2/14	Chemical Reactions 1 <i>Lab: Plotting Chemical Data</i>	S&Z 18.1-18.2, [F 9.7-9.8] S&Z 16.4-16.5 [F 9.14]	Site Char 1 due
3	2/19	Chemical Reactions 2 <i>Lab: Problem Set 1</i>	S&Z 18.3-18.4 [F 9.11]	
	2/21	Chemical Reactions 3 <i>Lab: Soil Sampling</i>	S&Z 18.5-18.6 [F 9.9-9.10, 10.6.7]	Plotting Lab due
4	2/26	Isotopes <i>Lab: Soil Texturing & Classification</i>	S&Z 20.1-20.6 [F 9.12]	PS 1 due
	2/28	Chemical Evolution <i>Demo: Chemical Speciation (PHREEQ)</i>	S&Z 21.1-21.4	Soils due
II. Solute Transport & Contaminant Behavior				
5	3/4	Overview of Transport/Advection & Diffusion <i>Lab: Review</i>	S&Z 19.1-19.2 [F 10.6.1-10.6.3]	
	3/6	<i>WI AWRA Meeting, Brookfield</i> EXAM 1 – Groundwater Chemistry		
6	3/11	Dispersion <i>Lab: Review of Heads & Gradients (PS2)</i>	S&Z 19.3-19.5 [F 10.6.4-10.6.5]	

6	3/13	Role of Heterogeneities in Transport <i>Lab: Simulation of Transport</i>	S&Z 19.6	
7	3/18	Measuring Transport Parameters <i>Lab: Water Analysis</i>	S&Z 19.8	PS 2 due
	3/20	Intro to Contaminant Hydrogeology <i>Lab: Water Analysis</i>	S&Z 22.1-22.2 [F 10.7]	Simulation due
	3/24-28	Spring Break	Have Fun!	
8	4/1	Plume characteristics & Reactive Transport <i>Lab: Problem Set 3</i>	S&Z 22.3 [F 10.6.6-10.6.7]	Water Analysis due
	4/3	NAPL Behavior <i>Lab: Site Characterization2 - GW Flow</i>	S&Z 22.4	
III. Site Investigation & Remediation				
9	4/8	Geologic & Hydrogeologic Investigations I <i>Lab: Site Characterization2 - GW Flow</i>	S&Z 7.1 - 7.4	PS 3 due
	4/10	EXAM 2 transport & contaminant behavior		
10	4/15	Geologic & Hydrogeologic Investigations II <i>Lab: Site Characterization3 - Plumes</i>	S&Z 7.5- 7.6 [F 12.3-12.7]	Site Char 2 due
	4/17	Water Sampling <i>Lab: Sampling (possible trip 4/19)</i>	S&Z 16.6-16.8 [F 10.3-10.4]	
11	4/22	Contaminant Site Investigation Techniques <i>Lab: Site Characterization3 - Plumes</i>	S&Z 22.5-22.6	
	4/24	NC GSA (Evansville, IN) Celebration of Scholarship		Site Char 3 due
12	4/29	Remediation: Source Containment & Removal <i>Lab: Plume Busters</i>	Read D&S 20.1-20.4 (thru p. 423), 20.7 Skim D&S 20.5-20.6 [F 10.8.2-10.8.3]	
	5/1	Remediation: Bioremediation & Abiotic Chemical Destruction <i>Lab: LUST Site Visit</i>	D&S 21.1-21.3 [F 10.6.7]	
13	5/6	Slug Tests		
	5/8	Borehole Geophysics		Slug Tests due
14	5/13	Field Trip to Redevelopment/Remediation Site		Geophysics due
	5/15	Final Exam		