SUBSURFACE CONTAMINANT TRANSPORT AND REMEDIATION
(Upper level course, intended for senior and graduate students)

Course Description:

The course will include a discussion of the important physical, chemical, and biological processes that influence the migration of inorganic and organic contaminants in the subsurface. Emphasis will be placed on more complex, non-ideal or multi-phase systems. Discussions will focus on important factors influencing contaminant transport and therefore, remediation. Examples will be used from real-world contaminant remediation problems, as well as academic research. Students will be required to work on their own, and to take part in class discussions and group investigation.

Prerequisites:

Required: Hydrogeology (GE3850) or equivalent; Basic Chemistry
Recommended: Groundwater Eng. (GE4800); Groundwater Site Investigation (GE4810).

Instructor:

NAME OF INSTRUCTOR; Department of Geological and Mining Engineering and Sciences
Office: xxx DOW Environmental Sciences Building
Phone:
Email:;
Office Hours: Contact by phone or e-mail anytime to arrange time to meet. You can also stop by my office. I will do my best to make myself available to answer your questions.

Course Goals:

Goal of course is to increase your awareness of factors influencing the transport of contaminants in the subsurface and to improve your confidence in tackling complicated, ill-defined site contamination problems. By doing so, you will improve your critical thinking skills and your ability to make knowledgeable, well thought-out assumptions and decisions that are required in solving real-world or research problems.

Course Requirements:

Grades will be based on class participation, group work, and individual performance. All aspects of this class will be open-book. Assignments and exams are designed to introduce you to the synthesis and analysis of real-world data and information.

- There will be 2 graded exams; each will be take-home and open-book. If your are unhappy with your performance (grade) on an exam, you will be provided the opportunity to re-communicate your thoughts and ideas to me verbally as many times as necessary until you understand and can convey to me the concepts addressed in the exam.
- You will be asked to contribute to two group projects/exercises that will be graded based on performance and participation and must be completed to pass the course. Smaller group work will also be used during class to learn and discuss course material.

- Preparatory reading assignments/activities will be given to help introduce new material and help focus class discussions. Unannounced quizzes on preparatory material may be given at the start of class.
- Since the class will be centered on student participation and discussion, it is important that you attend class. Missed class time will reflect negatively on your grade.
- There will be no final exam. Instead, students will be asked to submit their class notebook at the end of the semester for review.
- All deadlines set for submission of work must be honored. Late work will not be accepted. Due dates for items listed below will be better defined during the first few weeks of the course.

Group Projects:

Two group-oriented projects/assignments will be required for this course.

1. A debate over an environmentally controversial remediation "technology", such as natural attenuation. The class will be divided into two teams: one for, one opposed. You team will be responsible for formulating your arguments in support of your side. In order to successfully defend and support your side, your team will also have to prepare for and anticipate the arguments of the other team.
2. Students will be divided into teams of 3 or 4 and asked to examine data from a contaminant site. Your group is to determine (from the data provided) what factors might be influencing the transport and remediation of the contaminant. You will also be asked to recommend a remediation technology for the site based on the data provided, as well as local community interest and views, the budget available, and the risk of human exposure.

Grade Determination:

Grade Division	Week Assigned	Week Due	Percent of Total Grade
Exam 1	5	6	20%
Exam 2	11	12	20%
Group Project 1	4	8	15%
Group Project 2	9	14	15%
Quizzes	--	--	10%
Attendance	--	--	10%
Notebook	--	15	10%

Texts:

No text is required for this course. The following are a recommend as resources to facilitate learning: *A copy of these books will be made available to you in the campus library.*

1) Fetter, C.W., Contaminant Hydrogeology, 2nd Edition, Prentice Hall, 1998.
2) Domenico P.A. and F.W. Schwartz, Physical and Chemical Hydrogeology, 2nd Edition, John Wiley and Sons, Inc., 1998.
3) Ingerbritsen, S.E. and W.E. Sanford, Groundwater in Geologic Processes, Cambridge University Press, 1998.
4) J.A. Tindall and J.R. Kunkel, Unsaturated Zone Hydrology for Scientist and Engineers, Prentice Hall, 1999.

Topics Covered in Course:

Below are some of the topics I feel would be important to discuss in this course. Input/interest from students (you) throughout the course will help to better shape the material covered and the timeline for the course.

- Review of fundamentals of groundwater flow
- Solute transport in:
  - Ideal, fully saturated, homogeneous systems
  - Unsaturated, multiphase systems
  - Heterogeneous, anisotropic systems
- Remediation of contaminants in ideal, multiphase, and heterogeneous systems

In addition, the items listed below can affect the transport and remediation of contaminants in the subsurface. Their importance will vary depending on the specific system being investigated. As a class we will choose example remediation sites to investigate and discuss. We will examine how some of the factors listed below influencing the way contaminants are transported and removed from the subsurface. I feel it is also important to discuss/develop ways to differentiate between processes that might control the trends we observed in certain data sets.

Transport:	**Sorption:**	**Biodegradation:**	**Chemical Reactions:**
Advection	Kinetics	Kinetics	Decay/Transformation
Dispersion	Reversibility	Bioavailability	Chemical oxidation
Diffusion	Effects of organic carbon	Persistent organic contaminants	Toxicity of daughter products
	Hyrdophobicity/Solubility		