Expanded Course Outline
HYD 146 / GEL 156: Hydrogeology and Contaminant Transport
5 Units

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Office hours: Tuesday & Thursday, 10:30 AM – 12:00 Noon, and by appointment.

Prerequisites: HYD 144 or ECI 144 or equivalent

Textbook: Physical and Chemical Hydrogeology by P. A. Domenico and F. W. Schwartz (1998)

Grading:

Labs	30%
Problem sets	15%
Midterm exam	25%
Final exam	30%

Lecture Objectives:
Provide foundation for addressing groundwater flow and contamination problems. In the first 5 weeks we review fundamental principles, describe the anatomy of typical aquifers, discuss how to characterize such aquifers, and introduce some basic tools for analyzing the physical flow and transport processes. In the second 5 weeks, we discuss the occurrence of natural inorganics in groundwater (chemistry), use of chemistry to define regional flow paths, and physical and chemical processes of pollutant transport. The lectures emphasize both theory and concepts, often discussing how the 'real world' may or may not be adequately represented with certain methods of analysis.

Laboratory/Discussion Objectives:
Reinforce concepts introduced in lecture and introduce several tools needed for aquifer characterization and analysis with particular focus on pollutant transport. The tools include practical methods of conducting and analyzing field-well-test data and interactive groundwater modeling techniques. The lab also includes conduct of a field-pumping test, entailing at least one-half day per student on a weekend. The final lab covers 3 weeks and involves analysis of basic geology, groundwater circulation, and pollutant transport in a groundwater basin. The write-up of the final lab is expected to be rather professional and constitutes a term paper of more than 10 pages. Most of the 2- to 3-hour laboratory meeting consists of lecture and discussion on basics and lab exercises.

VERSION 1.0

APPROXIMATE AGENDA, HYD 146 / GEL 156 (HYDROGEOLOGY AND CONTAMINANT TRANSPORT)

Week	Topic	Reading**	Problem set	Laboratory (Wed. 2-5)
1	Introduction; Contaminant transport concepts; Review of flow equations; Aquifer testing	p. 1-32 p. 33-51 **p. 58-73** **p. 103-128**	1: Basics; Darcy's Law	1: Advanced pumping test analysis (Wellbore storage problem)
2	Hydraulic conductivity of layered and heterogeneous media; Statistical distribution of hydraulic conductivity; Statistical correlation; REV concept; Fractured rock hydrology	p. 75-101		2: Field pumping test, Campbell Tract
3	Groundwater and heat flow	**p. 191-213**		2: cont'd: Pumping test discussion, drawdown & recovery analysis, well efficiency, software use
4	Flow net review; Groundwater models (numerical)	p. 75-101 **p. 136-142** **p. 142-147**		3: Sand box experiment and flow nets
5	Groundwater models (numerical); Case studies; Solute transport: physical processes	p. 159-164 **p. 215-236**		4: Groundwater modeling experiment
6	Solute transport: physical processes, chemical processes	**p. 282-285** **p. 296-299** **p. 344-371**		
7	Solute transport: chemical and biological processes, examples	**p. 372-382**		5: Microcosm ("ant farm") transport experiment
8	Groundwater chemistry: basics and review, reactions on surfaces and pollutant transport, oxidation reduction reactions	**p. 238-241** p. 242-248 **p. 248-254** p. 255-266 **p. 270- 276.5** p. 276.5-280 p. 303-319	2: Quantitative analysis of "ant farm" experiment	6: Groundwater basin analysis
9	Groundwater chemistry: kinetics, nitrates, groundwater chemistry evolution, display of data, case study	p. 393-413		6: continued
10	Solute transport: vadose zone and multiphase problems; Groundwater remediation; Isotope methods in groundwater	p. 417-442 **p. 319-324**		6: continued

Reading codes: gray means "subject to revision"; **boldface means "required"; normal typeface means "optional."