GROUNDWATER FLOW MODELING

Instructor: H.M. Haitjema, haitjema@indiana.edu

Fall 2004

Time & location: **TR 8:00 am. – 9:15 am. in PV275**

Course number: **E554 sect.#: 25152**

Office hours: **TR 9:30 am.–10:30 am. or by appointment SPEA 439.**

Secretary: **Genia Marvin 855-0563 euasher@indiana.edu**

Teaching Assistant: **Maksym Gusyev, mgusyev@indiana.edu**
office hours: MW 2:30-4:00 pm. R 2:30 -3:30 pm. room 426.

Class text: **'Analytic Element Modeling of Groundwater Flow', H. M. Haitjema, 1995, Academic Press, Inc., San Diego.**

Recommended Reading:
(1) 'Applied Groundwater Modeling. Simulation of Flow and Advective Transport', Mary P. Anderson and William W. Woessner, 1992, Academic Press, Inc., San Diego
(2) 'A Civil Action', Jonathan Harr, Vintage Books, 1995

Course Description

The student is introduced to the fundamentals of groundwater flow modeling, which are demonstrated through exercises in one-dimensional and radial flow. Two-dimensional flow is treated by use of a semi-analytic approach and is applied to simple cases of regional flow. Streamline tracing is discussed to study the spreading of contaminants. As part of the course the student will perform a computer modeling exercise using the analytic element model GFLOW. During the second part of the course more complex modeling issues are being discussed, including the modeling of 3D and transient flow. The student is also introduced to alternative modeling techniques, such as finite elements and finite differences, particularly the use of the popular USGS MODFLOW model.

Course Objectives

To familiarize the student with the basics of groundwater flow modeling. The student will be trained to solve elementary groundwater flow problems and is instructed how to address more complicated problems. The emphasis of the course is on independent problem solving, rather than on the use of "canned" programs.

Course Grading

Midterm	(30%)	October 12 - take home, due: October 19 (in class).
Modeling exercise	(30%)	October 19 - hand out, due: November 23 (in class)
Final exam	(30%)	Thursday December 16 - final exam (in class) 8:00 - 10:00 am.
Homework	(10%)	handed out weekly, due after one (1) week.

COURSE OUTLINE E554

week	**subject**	**section**
1	Basic concepts	chapter 2
2	1D flow, discharge potentials, flow nets	3.0 - 3.1.7
3	Superposition, method of images	3.1.8 - 3.1.16
4	1D flow with recharge	3.1.17 - 3.2.2
5	Radial flow with recharge, streamlines, travel times	3.2.3 - 3.2.8
6	Flow in multiple aquifers	3.3 - 3.3.3
7	Heterogeneous aquifers, review, Midterm handout	3.4 - 3.4.6
8	Analytic element method, **Midterm due**, Handout modeling project	3.5 - 3.5.3
9	Basic modeling concepts	5.3 - 5.3.6
10	Multi-aquifer wells, **project milestone 1 due**	3.3.4 - 3.3.5
11	Approximate vertical flow, **project milestone 2 due**	3.5 - 3.5.3
12	Transient flow	3.6 - 3.6.4
13	Finite Difference Method, **modeling project due**	handout
14	Using the USGS MODFLOW model	handout
15	**Presentations of projects**	...
16	Final exam	...