26:380:600:01: Applied Groundwater Modeling
Fall 2010 Syllabus

***Instructor*:** Dr. Lee Slater
***Office*:** 138a Smith Hall
Office Hours: T, 5:00 to 6:00 pm
***Meeting Time*:** T, 6:00 to 9:00 p.m. – Smith 127

Course Description

This graduate course will introduce you to the methods commonly used to model groundwater flow and solute transport in the subsurface of the Earth. The course is deliberately focused on applications of hydrogeological modeling methods to examine important flow and transport processes by making use of modeling software that you are likely to encounter in an environmental consulting environment after graduation. In order to be prepared for the modeling aspects of the class, students will be required to conduct intensive reading/study on theoretical aspects of specific flow and transport modeling approaches before each class

Course Objectives

This course will provide you with a comprehensive background in modeling of groundwater flow and solute transport in the subsurface. The growing importance of groundwater modeling tools in evaluating water resources, water quality and contaminant transport will be evaluated. The primary objective of the course is to provide you with sufficient training in the fundamental theory and application of groundwater modeling to be able to develop the skill sets required to tackle basic environmental problems that are commonly addressed via groundwater flow and solute transport modeling. Although the theory will be reviewed (and you will be expected to conduct independent reading on the theory outside of class hours), the focus of this class will be on applying a suite of different hydrogeological modeling methods to examine flow and transport processes in the Earth. The course will be designed to provide a hands-on, inquiry driven learning experience.

A major task in this class will be the "*Modeling Project*" whereby you will progressively work on the construction of a model to simulate groundwater flow in a peatland in Maine. You will be encouraged to think about this problem early in the semester and will have opportunities to work on specific aspects of this model as we progress through the theoretical components of the class. Your model will be completed towards the end of the semester and will count for 40% of your total grade for this class.

Specific Learning Objectives:

- Competence in applying groundwater modeling and solute transport modeling methods
- Ability to set up a flow or transport model based on available data and known constraints
- Appreciation of uncertainty in groundwater modeling and transport and methods for uncertainty analysis
- Familiarity with popular modeling packages used in industry such as Visual ModFlow
- Appreciation of parameter estimation methods and non-uniqueness
- Improved understanding of the fundamental theory behind popular approaches to groundwater modeling and solute transport

Text:

The **required** text for the class is:
Anderson, M.P. and Woessner, W.W., 2002, Applied Groundwater Modeling: Simulation of Flow and Advective Transport, Academic Press, San Diego, CA

Other recommended reference texts include:
Kresic, N., 2006, Quantitative Solutions in Hydrogeology and Groundwater Modeling, CRC Press
Hill, M.C., 2007, Effective Groundwater Model Calibration: With Analysis of Data Sensitivities, Predictions and Uncertainty, John Wiley and Sons, Hoboken, New Jersey
Bear, J. and Cheng, A.H.D., 2010, Modeling Groundwater Flow and Contaminant Transport (Theory and Applications of Transport in Porous Media), Springer, New York
Fitts, C.R., 2002, Groundwater Science, Academic Press, ISBN 0122578554
Bair, S. and Lahm, T.D., 2006, Practical Problems in Groundwater Hydrology, Prentice Hall, 168 pp
Schwarz, F.W. and Zhang, H., 2002, Fundamentals of Groundwater, Wiley, ISBN 0471137855
Fetter, C.V. 2001, Applied hydrogeology, Fourth edition , Prentice Hall, ISBN 0130662399

The topics covered largely follow the order of Anderson and Woessner:

1. Introduction to Modeling
2. Equations and Numerical Methods
3. The Conceptual Model and Grid Design
4. Boundaries
5. Sources and Sinks
6. Profile Models
7. Special Needs for Transient Simulations
8. Model Execution and Calibration
9. Documenting and Reporting of a Model Study
10. Postaudits: How Good are Predictions?
11. Particle Tracking of Groundwater Flow and Advective Transport of Contaminants
12. Advanced Topics in Groundwater Modeling

Your Assignments

Assignments for this class will take four forms:

- *Take home assignments*: You will need to write up in class modeling exercises when set – these are due in class the following week†
- *Mid-term*: in class (closed-book) format – time TBA
- *Quick quizzes:* in-class (closed book) format
- *Modeling project:* due the last day of class

†Write ups of the laboratory work are due in class the week following the lab. All labs must be typed up and show all necessary calculations. I will not accept hand-written assignments.
Assignments cannot be handed in late for grading – students that do not hand in the assignment in the following class will get a 0 for that assignment. This policy is strictly enforced!

Grading:

The breakdown for the grading is as follows.

- *Take home assignments/lab write-ups*: 25%
- *Mid-term*: 25%
- *Quick quizzes:* 10%
- *Modeling project: 40%*

SERIOUS STUFF:

Americans with Disabilities Act Statement: If you need accommodations because of a documented disability, contact the Disabled Student Services Office on x5300

Academic Honesty Policy: Cheating in any form will not be tolerated. The first occurrence of any of this behavior will result in a grade of "F".