GEOL5250 Groundwater Modeling

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Office hours: Wednesdays 3:00-5:00pm. *If you plan to meet with me outside of office hours, please contact me first*.
Course website: jamesheiss.com/GEOL5250F19.html

Overview
The objective of this course is to familiarize students with the concept and practice of mathematical and numerical modeling of saturated and unsaturated fluid flow and solute and reactive transport in the subsurface. By the end of this course, students will be able to:

- Understand and formulate mathematical representations of flow and transport
- Understand the art of groundwater modeling, the basic approach, and how to avoid common pitfalls.
- Understand the basics of how to use industry-standard modeling software such as MODFLOW, MT3D, SEWAT, SUTRA, and PHT3D and associated GUIs.
- Know what modeling tools are available and which types are appropriate in particular situations.
- Construct and use a groundwater flow and solute transport model to answer a question or understand a process.
- Read and understand other modeling studies critically and evaluate them.

The final goal is not expertise in particular software, rather the ability to pick up a modeling tool and figure out how to use it. The course will be largely hands-on conceptualizing, constructing, running, post-processing, and analyzing groundwater models.

Recommended Textbooks
Applied Groundwater Modeling, by M.P. Anderson and W.W. Woessner, Academic Press, 2002
Modeling Groundwater Flow and Contaminant Transport, by J. Bear and A.H-D. Cheng Singer, 2010
Applied Contaminant Transport Modeling, by C. Zheng and G.D. Bennett, John Wiley and Sons, 2002

Email
Any email that you send to me must have GEOL5250 at the beginning of the subject line. Any email that you receive from me will have GEOL5250 in the subject line. My inbox is set to filter emails with this in the subject; if it isn't included I could miss your email!

Course Requirements
In-class Exercises
One or more modeling exercises may be conducted during any class period. These will be given credit in approximate proportion to the effort required through participation, completion, and in some cases deliverables (such as graphs, simulation results, or short write-ups).

Assignments
Out of class assignments will be assigned periodically. These will be due in class on the due date.

Journal Article Critique
Select a paper of your choice with a groundwater modeling component and outline the problem being addressed, the modeling technique implemented, note details and assumptions (boundary conditions,

model parameters, etc.) and discuss the results. Assess whether you think the model approach was correct and identify problem areas that you would do differently. The assignment includes a short written critique (2-3 pages, 11 pt, Times, 1.5 line spacing, 1 inch margins) and an informal ~7 minute presentation of the critique. See the PDF on the course website for suggestions on how to critique scientific journal articles.

Course Project
Students will be required to complete a course project involving the development and application of a groundwater model. The specific topic is optional. A project that contributes to ongoing thesis research is encouraged. A 1-page proposal for the final project will be due early in the semester. Project ideas must be approved by your professor prior to submission. The proposal should contain the following: a clear justification of the project and what issue or question it will address, 2) a description of the modeling methods that will be used, 3) discussion of what you might learn or accomplish (anticipated results). A final report is due at the end of the semester along with an in-class presentation. This is a class assignment (not a formal research project); the goal is to explore an idea and generate some preliminary results that you can build on later. More details will follow.

Readings
Required readings will be handed out and discussed in class.

Required background
A course in Hydrogeology or equivalent and Calculus are required. I assume familiarity with calculus, matrices, and basic programming skills. Familiarity with MATLAB or Python is recommended.

Classroom and Software
The course will be held in Olney 312. Software requiring licenses will be available on the computers for use during class and the computers will be accessible outside of class hours.

Grading

Participation and in-class exercises	20%
Assignments	40%
Paper Critique	5%
Final Project	35%
Total:	100%

*Grades are rounded to the nearest tenth.

Percentage	Letter Grade
>92	A
90 – 92	A-
88 – 89	B+
83 – 87	B
80 – 82	B-
78 - 79	C+
73 – 77	C
70 - 72	C-
68 – 69	D+
60 – 67	D
<60	F

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Applied Groundwater Modeling, by M.P. Anderson and W.W. Woessner, Academic Press, 2002.

Modeling Groundwater Flow and Contaminant Transport, by J. Bear and A. H-D. Cheng, Springer, 2010.

Applied Contaminant Transport Moeling, by C. Zheng and G.D. Bennett, John Wiley and Sons, 2002.

Student Survey

Name: _____ Date_____

How many semesters of chemistry have you completed? _____

How many semesters of physics have you completed? _____

How many semesters of calculus have you completed? _____

Have you taken a hydrogeology course? _____

Have you taken a hydrology course? _____

Which program have you enrolled in?

MS Environmental Studies ____

M.S. Environmental Engineering ____

PhD Civil ____

PhD Environmental Chemistry ____

PhD Intercampus Marine Science (IMS) ____