ERTH656 -- Groundwater Modeling (also offered as CEE623)

Course Meets: TR, 1200-1315 (Online via Zoom)
Prerequisite: ERTH455 (or similar courses) or instructor consent
Instructor: Aly El-Kadi, elkadi@hawaii.edu

Extra Readings: List of textbooks

http://www.bing.com/images/search?q=groundwater+modeling+textbooks&qpvt=groundw ater+modeling+textbooks&FORM=IGRE

Classic textbooks

- Bear, J., and A. H.-D. Cheng. 2010. Modeling Groundwater Flow and Contaminant Transport (Theory and Applications of Transport in Porous Media), Springer.
- Anderson, M.P., and. W.W. Woessner. 1992. Applied groundwater modeling simulation of flow and advective transport, Academic Press, San Diego.
- Bear, J., and A. Verruijt. 1987. Modeling Groundwater flow and Pollution, Reidel, Boston.
- Kinzelbach, W. 1986. Groundwater Modeling, An Introduction with Sample Programs in BASIC, Elsevier.

Course Content

This course emphasizes the practical aspects of modeling, where theory and development are reduced and model applications and limitations are stressed. Case studies are included in the course with hands-on modeling. Students will study the popular Groundwater Modeling Package (GMS; http://www.aquaveo.com/gms). Course synopsis is listed below.

- Review of math and hydrogeological concepts
- Solution techniques
  - Analytical
  - Numerical
  - Finite difference method
  - Finite element method
- Hands on model use
- Groundwater Modeling System (GMS)
  - MODFLOW
  - MODPATH
  - MT3DMS
  - SEAWAT
  - FEMWATER
- Case studies

EARTH Learning Objectives:

The Department of Earth Science Department has defined 4 and 5 learning objectives for the Masters and Ph.D. degree programs, respectively. For Masters, they are (1) Technical knowledge, (2) Scientific method, (3) Communicate geological knowledge, (4) Employability/Contributions

Post-Graduation. For Ph.D., an additional SOL is required, i.e., (5) Expertise in a sub-discipline. This course directly incorporates content relevant to some of those:

- SLO1 - student will learn about the relevance of groundwater hydrology and modeling to the understanding and providing for human needs, and the impacts on society and planet Earth.
- SOL2 - graduates are able to examine construct scientific hypotheses and define and carry out analyses
- SLO3 - student will reconstruct knowledge in a written report (final project).
- SLO5 - in all assignments, student will evaluate, interpret, and summarize basic principles to explain complex hydrological phenomena.

Course Goals

This class is aimed at advancing the students' modeling skills, not only for the utilized software, but also for all hydrology related models. Modeling is an important expertise that enhances someone chances for working as either a researcher or a consultant.

Assessment and Grading

Final and homework assignments are in the form of take-home projects. The final's grade will be based on a report in the form of a technical report and may include oral presentation by each student.
Grade: Homework 30%, Final project 70%

Class Format

Most lectures include hands-on model application. Each student will follow the instructor's steps as tutorials are presented and discussed. The aim, after a few lectures, students will be proficient enough to apply the methods without following the written instructions. It is helpful if students practice with the tutorials before the respective class. The students are given a temporary license to use the software on their own personal computers/laptops.

Class webpage:
https://sites.google.com/a/hawaii.edu/gw-modeling/
GMS can be downloaded from:
http://www.aquaveo.com/downloads