

Introduction to Hydrogeology: GLY-4822

Meeting time: 10:00-10:50 M, W, F

Meeting location: GC-283B

Course Level: Undergraduate 4822

Sections: 1

Web page: <http://www.fiu.edu/~sukopm/GLY4822/GLY4822.htm>

Course Catalogue Description

GLY 4822 Introduction to Hydrogeology (3). Principles of groundwater flow, determination of aquifer properties, geologic factors influencing groundwater flow and quality, legal/regulatory framework for hydrogeology. Prerequisite: One college-level course in physics, chemistry, geology, and calculus, or permission of the instructor. (S)

Instructor: Dr. Michael Sukop

Telephone: 305-348-3117

E-mail: sukopm@fiu.edu

Department: Earth Sciences

Office: PC-346A

Office Hours: M, W 11 to 12, as available, and by appointment

Outline

1. Introduction
2. Review
 - a. Math
 - i. Calculus
 1. Slopes
 2. Derivatives
 3. Partial derivatives
 4. Numerical derivatives
 5. Integrals
 - ii. Logarithms
 - b. Tools
 - i. Excel 'tricks'
 - ii. MATLAB
3. Hydrologic cycle
4. Hydrologic processes and stochastic hydrology
5. Ground Water Basics
 - a. Porosity and effective porosity
 - b. Total, elevation, and pressure heads
 - c. Gradient
 - d. Hydraulic conductivity
 - e. Flux and Darcy's Law
 - f. Average pore water velocity
6. Hydrogeology
 - a. Aquifers and confining beds

- b. Transmissivity and storativity
 - c. Major aquifers and their geologic settings
- 7. Fractured and karstic media
- 8. Mathematics of ground water flow
 - a. Derivation of Laplace Equation
 - b. Derivation of Poisson Equation
 - c. Boundary value problems
 - i. Analytical solutions
 - ii. Numerical solution
 - iii. Regional flow problem
 - d. Derivation of transient flow equation
 - i. Numerical solution
- 9. Ground water flow modeling with MODFLOW
- 10. 1-D Chemical Transport
 - a. Diffusion Equation
 - i. Derivation of PDE for 1-D Diffusion
 - ii. Boundary conditions
 - 1. Constant concentration boundaries (Dirichlet BC)
 - 2. No flux boundaries (Neumann BC)
 - iii. Initial conditions (Heaviside functions)
 - iv. Analytical solutions
 - v. Finite difference solution
 - vi. Excel model
- 11. Dispersion
 - a. Mechanisms
 - b. Poiseuille flow/Taylor dispersion
 - c. Estimating dispersion
 - i. Peclet number correlations
 - ii. Scale correlations
- 12. Retardation
 - a. K_d , linear isotherm
 - b. K_{oc}
- 13. Convection Dispersion Equation
 - a. Derivation of PDE for CDE
 - b. Boundary and initial conditions
 - c. Analytical solutions
 - d. Inverse modeling of solute transport; CXTFIT/STANMOD
 - e. 2- and 3-D analytical solutions
 - f. Particle Tracking/Pathline Models
 - g. MT3D
- 14. Hydrogeologic investigations
 - a. Drilling and well installation
 - b. Slug and aquifer testing
- 15. Seawater intrusion (Ghyben-Herzberg)
- 16. Ground water chemistry
 - a. Major ions, charge balance, and Piper diagrams

- b. Nitrogen and Phosphorous
- c. Cation exchange
- d. Redox reactions: O_2 , NO_3^- , $Mn(II/IV)$, $Fe(II/III)$, SO_4^{2-} , CH_4

Assignment Dates

Weekly assignments will be handed out on Wednesday and will be due the following Wednesday.

Performance Measures, Grading/Attendance Standards

Attendance: Participation in classroom instruction and computer exercises is critical to successful completion of this course. More than 3 unexcused absences will result in one letter grade reduction; more than 6 will result in a two letter grade reduction.

Homework: Homework assignments will be given weekly and will generally consist of short reports on specific exercises. English, spelling, units, significant figures, quality of graphics, accuracy of analysis, and quality of evaluation will all be considered in grading the homework. You are encouraged to work together to develop your understanding, but you must complete all assignments yourself; copying the work of others (including from the Internet) is unacceptable and will result in a grade of F for the course. In addition, you will probably not be able to successfully complete the quizzes and examinations without having done the homework. Late homework will be reduced 25% for each late day. These assignments will account for 1/2 of your grade.

Quizzes: 1/8 of grade. 10-minute quizzes will be administered weekly or as appropriate following completion of the homework assignments. The sum of all quiz grades will be weighted to account for 1/8 of your overall course grade.

Examinations: 1/8 of grade each. One mid-term and one final examination will focus on concepts, theory, and practical computations. Examinations will be based on lecture, homework, and quiz material.

Projects/Presentations: An in-class presentation of a final project consisting of a hydrogeological description of an area or an analysis of a problem will constitute 1/8 of your grade. Your presentation will be graded on content and professional quality. You will submit a one page description of your project concept early in the semester. Individual and group projects are possible, but equal effort (and a regular full presentation) is expected from all group project participants. Presentations will be at the end of the semester.

Text

Franklin W. Schwartz and Hubao Zhang, 2003. Fundamentals of Ground Water, Wiley, New York. 583 p. ISBN: 0-471-13785-5

Companion web site:

http://jws-edcv.wiley.com/college/bcs/redesign/student/0,,_0471137855_BKS_1316____,00.html

Bibliography

Anderson and Woessner, Applied Groundwater Modeling: Simulation of Flow and Advective Transport, Academic Press, 1992.

Bennett, G.D., 1976. INTRODUCTION TO GROUND-WATER HYDRAULICS, U.S. Geological Survey, Techniques of Water-Resources Investigations, Book 3, Chapter B2. Available online at <http://water.usgs.gov/pubs/twri/twri3-b2/html/pdf.html>

Ingebritsen, S.E., W.E. Sanford, C.E. Neuzil. 2006. Groundwater in geologic processes. 2nd ed., Cambridge ; New York : Cambridge University Press.

Toride N., Leij, F.J. and van Genuchten, M. Th. (1995) The CXTFIT Code for estimating transport parameters from laboratory or field tracer experiments. Research Report No. 137, U.S. Salinity Laboratory, USDA-ARS, Riverside, CA. Available online.

Wang and Anderson, 1982. Introduction to Groundwater Modeling. W. H. Freeman and Company, San Francisco. 237 pp.