Introduction to Hydrogeology: GLY-4822

Meeting time: 12:30-1:45 T, Th
Meeting location: Charles E Perry (PC) 445
Course Level: Undergraduate 4822
Sections: 1
Web page: http://faculty.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:	Professor Michael Sukop, PhD
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Office Hours:	T, Th 2:30 to 4:30, 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/Python
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. Mathematics of ground water flow
    a. Derivation of 1- and 2-D Poisson Equations
    b. Boundary value problems
        i. Analytical solutions
        ii. Numerical solution
        iii. Regional flow problem
    c. Derivation of transient flow equation
        i. Numerical solution
8. Ground water flow modeling with MODFLOW and FloPy
9. Fractured and karstic media
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. Kd, linear isotherm
    b. Koc
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

Approximately weekly assignments will be due one week after they are handed out or provided by e-mail.

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 must write a coherent report that explains what is presented. 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 each group project participant. Presentations will be at the end of the semester.

Text

Fitts, Charles R., 2012 Groundwater Science, Edition 2, Academic Press. ISBN 0123847060, 9780123847065, 692 pages

Companion web site: http://booksite.elsevier.com/9780123847058/

Bibliography

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

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