CEE 172 GROUNDWATER HYDROLOGY
(Elective for CE and EnE)

Catalog Data: **CEE 172: Groundwater Hydrology (Credit Units: 4)** Topics include conservation of fluid mass, storage properties of porous media, matrix compressibility, boundary conditions, flow nets, well hydraulics, groundwater chemistry, and solute transport. Design projects and computer applications included. Prerequisites: CEE170 or MAE130A or consent of instructor. (Design units: 2)

Textbook: Domenico, P.A. and Schwartz, F. W. *Physical and Chemical Hydrogeology,* 2nd Edition, Wiley, 1998.

References: Handouts from instructor

Coordinator: Constantinos V. Chrysikopoulos

Course Outcomes: Students will:
Derive effective hydraulic expressions for various cases of heterogeneous subsurface formations.
Derive groundwater flow models from first principles.
Construct and apply appropriate groundwater flow net models.
Analyze field pumping test data.
Evaluate water quality data.
Use contaminant transport models for reactive solutes.
Predict the fate and transport of a contaminant in a water saturated aquifer.
Design and evaluate aquifer remediation procedures.

Prerequisites By Topic: Fluid mechanics. Basic calculus and differential equations.

Lecture Topics: Introduction to hydrogeology (1 week)
Characteristics of porous media (1 week)
Equations of flow, storage properties of porous media, matrix compressibility, boundary conditions and flow nets (2 weeks)
Well hydraulics, methods of aquifer analysis, pumping tests (2 weeks)
Groundwater chemistry (1 weeks)
Solute transport, concepts of dispersion, mathematics of mass transport, reactive mass transport (2 weeks)
Sources of groundwater contamination, remediation techniques (1 week)

Class Schedule: Meets for 3 hours of lecture and 1 hour of discussion each week for 10 weeks.

Computer Usage: Students will employ computers for the required project model simulations.

Laboratory Projects:

Professional Component: Contributes to the design experience and Engineering Topics courses of Civil Engineering and Environmental Engineering majors.

Relationship to Program Outcomes: CE - The course relates to Program Outcomes a, b, e, g, and k as stated at:
http://undergraduate.eng.uci.edu/degreeprograms/civil/mission
EnE - The course relates to Program Outcomes a, b, e, g, and k as stated at:
http://undergraduate.eng.uci.edu/degreeprograms/environmental/mission

Design Content Description

Approach: Students learn the engineering design process in the context of an integrative design project that constitutes the second half of the course. In this assignment, teams of 2-4 students are asked to predict the movement and fate of a trichloroethylene (TCE) plume within a well characterized aquifer. The specific objectives of the project are: (a) To employ analytical procedures and techniques presented in the classroom to field scale investigations. (b) To work with relatively complicated hydrogeological data. (c) To learn how to use existing numerical codes for contaminant transport in the subsurface. (d) To develop creative and original thinking. Students analyze groundwater level data in order to determine the direction of groundwater flow and the average hydraulic gradient. Using a set of available initial TCE concentrations in the aquifer the students estimate the initial location of the contaminant plume at the site. Subsequently, using the results from a pumping test the students determine the average hydraulic conductivity and groundwater flow velocity. Finally, using a contaminant transport model developed by the instructor the students predict the future movement and fate of the TCE plume. Five weeks of class time is spent providing the necessary background for the assignment and one lecture is devoted to the description of the design project. Each team submits a written report.

Lectures: 100%

Laboratory Portion: 0%

Grading Criteria:

Homework:	15%
Project:	15%
Midterm Exam:	30%
Final Exam:	40%
	100%

Estimated ABET Category Content:

Mathematics and Basic Science: ____credit units or ____%
Engineering Science: __1___credit units or _33__%
Engineering Design: ___2_credit units or __67_%

Prepared by: Constantinos V. Chrysikopoulos **Date:** July 2007

CEP Approved: Fall 2000