Groundwater Flow and Contaminant Transport

(CEMM428; 3 UG/ 4G Credit Hours)

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Course Description:
This course provides basics of groundwater flow and contaminant transport and also describes general methodology and simple applications of groundwater flow and contaminant transport modeling to geoenvironmental systems.

Prerequisites:
Basic chemistry, physics and calculus

Text Book:
Sharma, H.D., and Reddy, K.R., "Geoenvironmental Engineering: Site Remediation, Waste Containment and Emerging Waste Management Technologies," John Wiley & Sons, Inc., 2004 (ISBN: 0-471-21599-6); See: http://www.wiley.com/WileyCDA/WileyTitle/productCd-0471215996.html

Syllabus:

I. Introduction and Basic Principles

- Hydrologic Cycle and Groundwater
- Aquifer, Aquiclude and Aquitard
- Hydraulic Head and Aquifer Properties
  - Hydraulic Head
  - Porosity
  - Specific Yield
  - Hydraulic Conductivity
  - Transmissivity
  - Specific Storage and Storativity

II. Groundwater Flow Behavior

- Groundwater Flow in Aquifers
  - Flow in Confined Aquifer
  - Flow in Unconfined Aquifer
  - Methods to Solve Groundwater Flow Equation
- One-Dimensional Steady Flow
  - Uniform Aquifers
  - Stratified Aquifer
  - Spatial Variation of Hydraulic Conductivity
- Flow Towards a Pumping Well
  - Confined Aquifer
  - Unconfined Aquifer
  - Effects of Multiple Wells and Boundaries

- Pumping and Slug Testing
    - Pumping Tests
    - Slug Tests
- 2-D and 3-D Groundwater Flow
    - Groundwater Flow Nets
    - Groundwater Flow Modeling
    - MODFLOW

III. Contaminant Transport Processes

- Contaminant Transport Processes
    - Advection
    - Diffusion
    - Dispersion
- Chemical Mass Transfer Processes
    - Sorption and Desorption
    - Dissolution and Precipitation
    - Oxidation and Reduction
    - Acid-Base Reactions
    - Complexation
    - Ion Exchange
    - Volatilization
    - Hydrolysis
- Biological Process (Biodegradation)
- Contaminant Transport and Fate Modeling
    - Analytical Methods
    - Numerical Methods
    - MT3D, RT3D

IV. Environmental Applications

- Site Characterization
- Landfills
- Surface Impoundments
- In-Situ Barriers
- Groundwater Remediation
