

ENVE 372a

Environmental Transport Processes

Fall 2006

Time/Room: M W: 2:30 – 3:45
Room: Becton 102

Instructor: Professor Menachem (Meny) Elimelech
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Objective: To present a unified treatment of fluid and mass (chemical species) transport in environmental systems, emphasizing physical principles and mathematical formulation of problems. Applications to environmental and engineered systems $\frac{3}{4}$ such as groundwater, soils, river/lakes, reactors, and treatment processes $\frac{3}{4}$ will be presented.

Structure: Lectures – 2 per week
Homework on a weekly basis
Two midterms
Final exam

Grading: Homework: 20%
Midterm 1: 25%
Midterm 2: 25%
Final Exam: 30%

Course Contents

- Overview of Environmental Transport and Fate of Contaminants
- Introduction to Transport Phenomena

Principles of Fluid Transport

- Conservation of Mass: The Continuity Equation
- Conservation of Linear Momentum: The Navier Stokes Equation
- Applications of Conservation Laws to Fluid Flow Problems

Fundamentals of Mass Transport

- Principles of Mass Transfer
- Differential Equations for Mass Transfer
- Steady-State Molecular Diffusion
- Unsteady-State Molecular Diffusion
- Convective Mass Transfer
- Convective Mass Transfer between Phases
- Mass Transfer Coefficients

Thermodynamic Principles Relevant to Environmental Transport

- Properties of Chemical Contaminants
- Partitioning of Contaminants between Phases

Contaminant Transport in Groundwater

- Types and Sources of Groundwater Contaminants
- Groundwater Flow Equation
- Mass Transport Mechanisms in Groundwater (Diffusion, Advection, Dispersion)
- The Advection-Dispersion Equation
- Analytical Solutions of the Advection-Dispersion Equation
- Transformation, Retardation, and Attenuation of Contaminants in Groundwater
- Sorption and Partitioning of Contaminants in Groundwater and Soils

Transport Processes in Engineered Systems

- Riverbank Filtration
- Membrane Separation Processes
- Particle Filtration

Reference Books

No text book will be used. Relevant handouts will be given and/or posted on the class server.

The following books will be on reserve in the ENAS library:

Principles of Fluid and Mass Transfer

1. Welty, J.R., Wicks, C.E., Wilson, R.E., and Rorrer, G. "Fundamentals of Momentum, Heat, and Mass Transfer", 4th Edition, Wiley, 2001.
2. Geankoplis, C.J. "Transport Processes and Separation Process Principles (Includes Unit Operations)", 4th Edition, Prentice Hall, 2003.

Environmental Transport and Fate

1. Logan, B.E. "Environmental Transport Processes", Wiley-Interscience, 1999.
2. Clark, M.M. "Transport Modeling for Environmental Engineers and Scientists", Wiley-Interscience, 1996.
3. Schwarzenbach, R.P., Gschwend, P.M., and Imboden, D.M. "Environmental Organic Chemistry", Wiley-Interscience; 2nd edition, 2003.