ENV 6050 Advanced Pollutant Transport

Fall 2012

Instructor: M.D. Annable (Phone: 392-3294: 580D Weil Hall)

Grading: 2 Exams, Homework and a Design Project.
Exams 30%, Homework 20%, Project 20%

Text (suggested): Surface Water-Quality Modeling
by Steven C. Chapra (1997 McGraw-Hill, Inc.)

Class time: Period 6&7 12:50 pm – 2:05 pm T-Th BLK 213
Office Hours: Period 8 T-Th 580D Weil Hall

General Course Description: The primary focus of the course will be on transport processes in surface water bodies. The advective-dispersive transport equation will be developed and analytical solutions to boundary value problems presented. These solutions are applied to problems of mixing in surface water bodies with homework problems that include design considerations. A design project will look at maximum allowable mass discharge in a surface water system given water quality constraints (student can propose a design project matching their interests). Mixing in reservoirs and cooling pond design will be covered. The last portion of the course will look at application of transport theory to conduit contaminant transport in Karst spring systems.

Course Objectives and Outcomes:

a) *Objective*: Learn the fundamentals of diffusive and dispersive processes in fluid systems. Develop the advection-diffusion equation covering assumptions and limitations.
Outcome: Students will have a fundamental understanding of the physics of mixing in natural water systems.

b) *Objective*: Learn to work with solutions to the A-D equation for a variety of initial and boundary conditions. Apply the solutions to problems incorporating design decisions.
Outcome: Students will be able to determine the best model for describing a mixing process and can use the model to determine best design criterion.

c) *Objective*: Study complex systems including rivers and reservoirs and identify the simplifications used to solve problems.
Outcome: Students will be familiar with the types for problems engineers encounter in natural and engineered systems and some approaches used to solve these problems.

d) *Objective*: Present the steps involved in solving large-scale design problems focusing on the pollutant transport component. Carry out a design project.
Outcome: Students will gain design experience.

Course Outcome Assessment: Students will be evaluated on the objectives listed above through graded homework related to all four objectives listed. A design project that includes a proposal abstract, a detailed outline, and first and final drafts as evaluative steps will be used to assess objective d). Three exams will be used to assess the students capabilities with the material presented.

DATE (week of)	LECTURE
8-23	Introduction, Overview of problems investigated Qualitative review of processes, Mass balance Basic definitions and concepts [Lecture 1] (Lecture #s follow Chapra)
8-28	Reaction kinetics, mass balance [Lecture 2] Steady-state solutions [Lecture 3]
9-4	Solutions, reactors [Lecture 4] Feedback/forward systems [Lecture 5&6]
9-11	Molecular diffusion, Fick's law [Lecture 8] One Dimensional Solution [Lecture 9] Gradient-flux relationship
9-18	Random walk process [Lecture 10] Advection-Diffusion equation Basic solutions
9-25	Two and three dimensional solutions Boundary effects, Review
10-2	Turbulent diffusion Gradient Transfer Approach
10-9	Shear flow dispersion [Lecture 14] Mixing in Rivers Vertical, transverse, longitudinal mixing Estimating dispersion parameters
10-16	Exam Mixing in reservoirs [Lecture 16] Oxygen concentrations in rivers [Lecture 19]

DATE (week of)	LECTURE
10-23	BOD distribution, Case study [Lecture 20&21]

10-30	Energy for mixing
11-6	Discharge of heat loads in rivers [Lecture 30] Cooling pond design
11-13	Sediments [Lecture 17] Turbulent jets and plumes Buoyant jets Outflow diffuser design
11-20	Exam
11-27	Contaminant transport in Karst Spring systems
12-4	Radionuclides and metals
12-10	Exam week projects due