ENVR 285
Surface Water Quality: Modeling and Policy
Fall 2005

Class Hours: Tuesdays & Thursdays, 2-3:15pm

Location: Hooker Research Bldg Rm 0015

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Office Hours: After class or by appointment (I am usually available)

Text: Chapra, S. C., *Surface Water-Quality Modeling*, McGraw-Hill, 1997
(handouts on selected topics will also be distributed)

Prerequisites: Calculus and some nominal computer skills (e.g., Excel). Knowledge of a mathematical programming language (e.g., Mathematica, Matlab) would be useful, but is not required. Mass balance and kinetics concepts will be reviewed, so while ENVR 151 is not necessary, those that have taken or are taking this course will find it to be complementary.

Course Background:
Evaluating and regulating surface water quality has been a primary focus of environmental engineering since its inception. The initial motivation for developing models of surface water systems stemmed from concerns over the oxygen-depleting effects (e.g., BOD) of releasing treated and untreated wastewater into natural systems. Later, these models were expanded to include consideration of other "point sources" (usually industrial) discharging various forms of organic and inorganic contamination into waterways. As point source emissions declined due to regulatory action, "nonpoint" sources became a growing concern as observations indicated that significant contaminant loads were entering lakes, streams, and estuaries via runoff from rainfall events. Current regulatory efforts seek to characterize and prioritize the nation's impaired water bodies through the Total Maximum Daily Load (TMDL) program, and have resulted in renewed efforts to develop increasingly sophisticated and comprehensive surface water quality models.

Course Objectives:
This course is designed to provide students with a fundamental understanding of water quality modeling theory and application. Concepts related to mass balances, reaction kinetics, and transport will applied within a surface water systems context. Students will be expected to understand and apply various analytical and numerical methods in the development of surface water models. Models will be developed with an eye toward policy applications related to regulatory decisions, including the establishment of effluent standards, economically efficient wasteload allocation (e.g., tradable permit schemes), and facility siting.

Course Format:
The development of these models and their application to policy-related problems is a lengthy process, even when presented in somewhat simplified scenarios. These exercises involve numerous decisions regarding the problem formulation, the approach to be used, and the assumptions to be made, all of which require both time and focused thought. As such, the basis for grading in this course will be a series of (5-6) mini-projects, each designed to challenge the student's ability to integrate fundamental scientific and engineering principles into an applied setting. Grades will be determined based on the basis of student performance on these projects (85%), as well as involvement in class discussions and activities (15%).

A tentative schedule is presented below:

ENVR 285			
Surface Water Quality Modeling			
Fall 2005			
Lecture	**Date**	**Topic**	
1	30-Aug	Intro/Mass balances	
2	1-Sep	Rxn Kinetics	
3	6-Sep	Reactor theory	Project #1
4	8-Sep	Modeling Natural Systems (lakes, rivers)	
5	13-Sep	Parameter Estimation (OLS w/ &w/o dummies)	
6	15-Sep	Parameter Estimation (method of moments)	
7	20-Sep	Sedimentation/Benthic reactions	
8	22-Sep	Adsorption/Contaminant partitioning	
9	27-Sep	Contaminant transport modeling in rivers/streams	Project #2
10	29-Sep	Biochemical Oxygen Demand (BOD)	
11	4-Oct	Reaeration	
12	6-Oct	Derivation of Streeter-Phelps Eqn	
13	11-Oct	BOD-DO Deficit Models (coupled systems)	Project #3
14	13-Oct	Analytical Modeling BOD: point/nonpoint sources	
15	18-Oct	Numerical Modeling of Surface Water Quality	
	20-Oct	Fall Break	
16	25-Oct	Numerical Modeling of Surface Water Quality	
17	27-Oct	Numerical Modeling of Surface Water Quality	Project #4
19	1-Nov	Optimization/Linear Programming (LP)	
20	3-Nov	Optimization/Linear Programming (LP)	
21	8-Nov	Optimization/Linear Programming (LP)	
22	10-Nov	Regulatory Strategies/Optimal Wasteload Allocation	
23	15-Nov	Regulatory Strategies/Optimal Wasteload Allocation	Project #5
24	17-Nov	Diffusion/Dispersion	
25	22-Nov	Advective-dispersive transport	
	24-Nov	Thanksgiving	
26	29-Nov	Advective-dispersive transport	
27	1-Dec	Advective-dispersive transport	
28	6-Dec	Estuary Modeling	
29	8-Dec	Estuary Modeling	Project #6