SYLLABUS

1. **Number and Name: 16:375:541 – ENVIRONMENTAL MODELS**

2. **Credits and contact hours:** 3 credits, 2-80 minute lecture periods per week

3. **Instructor:** Christopher G. Uchrin

4. **Required Text:** none
   Reference Texts: Chapra, S.C., *Surface Water-Quality Modeling*, McGraw-Hill, NY, 1997, 844 pp.
   Thomann, R.V., and J.A. Mueller, *Principles of Surface Water Quality Modeling and Control*, Harper & Row, NY, 1987, 644 pp.
   Schnoor, J.L., *Environmental Modeling: Fate and Transport of Pollutants in Water, Air,and Soil,* John Wiley & Sons, NY, 1996, 682 pp.

5. **Specific Course Information**
   a. **Catalog Description***:* *Development and applications of environmental models discussed in terms of their ability to simulate and predict the workings of environmental systems and to communicate information and trade-offs between economic and conservation goals.*

   b. **Prerequisites:** Permission of instructor

   c. **Course Type:** Elective

6. **Course Goals**

   a. **Specific Instructional Outcomes (Course Objectives):** Students will be versed in the principles of surface water hydrology and pollution. Student problem solving skills will be enhanced through the use of homework projects and an engineering project involving considerable analytical and numerical skills.

   b. **Specific Student Outcomes (Learning Goals) addressed by the course include:**
   c. Ability to design a system, component or process to meet desired needs
   Instructional Activity: Successful completion of a modeling project focused on a surface water pollution application
   Assessment Activity: Individual grading of student projects focused on the formulation of a mathematical modeling system to analyze a complex water pollution problem

e. Ability to identify, formulate and solve environmental engineering/science problems
Instructional Activity: Successful completion of design project focused on surface a water pollution application
Assessment Activity: Individual grading of student projects focused on:
1. Theoretical development and application
2. Technical accuracy
3. Conclusions
4. Written presentation

k. Ability to use techniques, skills and modern environmental engineering/science tools necessary for engineering/science practice
Instructional Activity: Successful completion of design project and homework assignments incorporating advanced mathematical (computer) modeling techniques focused on surface water quality
Assessment Activity: Individual grading of student projects and homework assignments focused on using advanced engineering tools specifically for technical accuracy and visuals

7. Topics:

Lecture	Topic
1-2	I. INTRODUCTION: Definitions; Deterministic, phenomenological and stochastic models; modeling flow chart; Conceptual models; Simulation versus modeling
3	II. THE MASS BALANCE: Definition; Batch systems and applications
4-5	Completely mixed flow systems
6	Cells in series
7	Ideal plug-flow systems
8-10	Plug-flow with dispersion systems
11	III. MODEL ERROR ASSESSMENT AND RELIABILTY: Comparison of model predictions to true values; Diagnostic checks; quantification of error; Estimation of prediction reliability
12	IV. MULTI-DIMENSIONAL SYSTEMS: Total systems mass balance
13	Two-dimensional steady-state application
14-15	Finite section approximations/finite differences
16-17	V. MULTI-COMPONENT COUPLED SYSTEMS MODELS: Biochemical Oxygen Demand (BOD) – Dissolved Oxygen (DO) in streams
18	Sediment oxygen demand
19-20	Algal photosynthesis and respiration
21	BOD-DO dynamics in dispersive systems
22-24	Ecosystem (food-web) models
25-26	INTRO TO ATMOSPHERIC DISPERSION MODELS: Atmospheric stability; Dispersion; Effective stack height; Gaussian distribution models

Grading:	Homework	25%
	Exam 1	20%
	Exam 2	20%
	Final Exam/project report	35%

Prepared by: Christopher Uchrin 01/16/13