

## CEE 626

### Environmental/Hydrologic Systems Analysis

- Catalog data:** 20-CEE-626. Environmental/Hydrologic Systems Analysis. 3 cr. Development and use of mathematical model of complex environmental systems for analysis, control, and design. Advanced optimization techniques for parameter estimation, experimental design, and system design using simulation models. Illustrations of modeling techniques for a variety of environmental/hydrologic systems. Prereq: 20-257-627 or permission of Instructor.
- Prerequisites:** Math. Principles of Eng. Sys. (20-257-627) or permission of instructor.
- Textbook:** None required.
- References:** Extensive use of journal articles; Notes and homework assignments available at <http://www.cee.uc.edu/~juber/courses/cee626/cee626.html>
- Coordinator:** Dr. James G. Uber, 780 ERC, 513-556-3643, [Jim.Uber@uc.edu](mailto:Jim.Uber@uc.edu)
- Goals:** There are three major objectives. One is to explore some mathematical techniques that can aid in understanding how to effectively plan or design environmental and hydrologic systems. These techniques include classical mathematical methods (e.g., the Lagrangian method), benefit cost analysis, and mathematical programming (e.g., linear, nonlinear, and dynamic programming for continuous and integer-valued decision problems). The second is to understand that mathematical modeling is an art and to further develop modeling skills. The third is to appreciate the role of mathematical models; in general they do not provide easy answers to hard problems, but rather provide insight and understanding that assist our brain in making good decisions. Throughout the course, basic concepts from economics are combined with principles for analyzing physical systems, and specific problems are used to motivate the concepts.
- Lecture or Lab Topics:**
1. Distribution Network Hydraulic Design (2 hrs)
  2. Branched versus Looped Networks (2 hrs)
  3. Nonlinear optimization and hybrid approaches (3 hrs)
  4. Distribution Network Water Quality Design and Operation (1 hr)
  5. Booster Chlorination for Residual Control (1 hr)
  6. Optimal Operation and Location Models - Water Quality Dynamics and Linear Superposition (4 hrs)
  7. Linear Prog. (Simplex Method) and Mixed Integer Prog. (Branch and Bound) (4 hrs)
  8. Optimal Location Models - Maximum Covering Models (2 hrs)
  9. Optimal scheduling of Reservoir Releases (2 hrs)
  10. Dynamic Programming (3 hrs)
  11. Optimal Activated Sludge Process Design (Unit Sizing) (2 hrs)
  12. Engineering Economics Review (2 hrs)

### 13. Single Objective versus Multiobjective Optimization (1 hr)

**Computer  
Usage:**

Students make extensive use of Matlab for general numerical computation and programming projects and solution of optimization problems, as well as other tools (Excel, Excel Solver)

**ABET criterion  
3:**

a, b, c, d, e, f, g, h

**ABET criterion  
8:**

a, b, c, d

**Date prepared:**

January 21, 2004

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