

CEE 600

Chemistry and Biology of Environmental Systems

- Catalog data:** 20-CEE-600. Chemistry and Biology of Environmental Systems. 3 ug./gr. cr. Theory and design. Chemical principles of lime/soda ash drinking water softening, biological principles of activated sludge sewage treatment, design of drinking water chemical softening plants, and design of activated sludge sewage treatment plants.
- Prerequisites:** Chemistry, calculus, and principles of materials balance. 20-CEE-471. Introduction to Environmental Engineering. 3 ug. cr. Concurrent registration in: 20-CEE-601. Chemistry and Microbiology of Environmental Systems Laboratory. 1 ug./gr. cr.
- Textbook:** Viessman and Hammer, *Water Supply and Pollution Control*, 6th Edition, Addison Wesley, Menlo Park, CA, 1998.
- References:** Davis and Cornwell, *Introduction to Environmental Engineering*, 3rd Edition, McGraw-Hill Book Co., New York, NY, 1998.
- Coordinator:** Dr. Daniel B. Oerther, Assistant Professor of Environmental Engineering, 746 ERC, 556-3670, Daniel.Oerther@uc.edu
- Goals:** This course provides a detailed intro. to the chemistry & microbiology of environ. systems using the design of chemical drinking water softening plants & biological activated sludge sewage treatment plants as extended examples. This course builds upon concepts presented in Intro. to Environ. Engrg. & provides students with a design-emphasis understanding of two important processes in water quality protection. This course is intended to bridge the gap between the overview of water quality protection presented in the Intro. course & the field-based design and operation of full-scale systems for water quality protection.
- Lecture or lab topics:**
1. Overview of environmental regulations for water quality. (1 class)
 2. Overview of drinking water treatment. (2 classes)
 3. Chemistry of lime softening incl. pC-pH diagrams, solubility prod., predominance diagrams, & stoichiometry of softening reactions. (6 cl.)
 4. Design of chemical drinking water softening plants. (3 classes)
 5. Integration of chemical principles & engineering design with tour of a full-scale drinking water facility. (3 classes)
 6. Overview of wastewater treatment. (2 classes)
 7. Microbiology of activated sludge incl. kinetics & stoichiometry of microbial redox chemistry, identification of important microorganisms, & principles of microbial ecology. (6 classes)
1. Design of activated sludge sewage treatment plants. (3 classes)
Integration of microbiological principles and engineering design with tour of a full-scale wastewater facility. (3 classes)
- Computer usage:** Spreadsheet modeling for the design of drinking water & sewage treatment plants integrating chem. & biol. principles w/design examples

ABET criterion 3: in bi-weekly homework assignments & two, term-long design examples.
a, c, e, k
ABET criterion 8: a, b, e, f
Date prepared: December 30, 2002

Specific Examples of ABET Criterion 3

a: Two extensive homework assignments are used as vehicles to teach students about the design of drinking water chemical softening plants and wastewater activated sludge sewage treatment plants. The students are provided with a description of a influent stream for each plant. After reviewing general design strategies throughout the lectures, the students begin work on individual designs to meet regulatory requirements using the influent streams they have been given.

c: See the description in A, above.

e: As part of the design examples described above in A, students develop an individual solution to the design challenge.

k: See the description in A, above.

Specific Examples of ABET Criterion 8

a: Basic understanding of chemistry, physics, and biology as well as mathematics is integrated in the two extensive homework assignments. The students must use these skills to develop designs for a drinking water chemical softening plant and a wastewater activated sludge sewage treatment plant.

b: The lectures for chemistry include learning how to construct and use pC-pH diagrams and solubility/predominance diagrams to understand lime and soda ash softening of hard water. The lectures for biology include learning Monod and Haldane kinetics as well as the stoichiometry of bacterial growth on carbon, nitrogen, and phosphorus sources.

e: Two extensive homework assignments are used as vehicles to teach students about the design of drinking water chemical softening plants and wastewater activated sludge sewage treatment plants. The students are provided with a description of a influent stream for each plant. After reviewing general design strategies throughout the lectures, the students begin work on individual designs to meet regulatory requirements using the influent streams they have been given.

f: Chemical and biological principles are presented to support engineering design of water softening and activated sludge, respectively, as described above.