Environmental Engineering Course Sequence and Learning Outcomes for Civil Engineering Technology Majors at Southern Polytechnic State University

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Recent changes in the Georgia University System have prompted substantial modifications to almost all the professional programs in the state. This paper discusses changes proposed to satisfy the new credit hour requirements, while giving the civil engineering technology students the basic concepts in environmental engineering.

Background

During the 1995-1996 academic year, the Board of Regents of the Georgia University System made the decision to change all state universities and colleges from a quarter to a semester system. In addition to the modification of the academic term, the Board of Regents modified the basic college core and reduced the total credit hours required to obtain a four-year degree, in an attempt to unify all college requirements. In the quarter system the basic college core represented 28.5% of the total credit hours, while in the new system the basic core represents 33.6%.

For Southern Polytechnic State University (SPSU), and specifically for the Civil Engineering Technology (CET) Department, the total requirement of 210 quarter-credit-hours was reduced to 128 in the semester system. With this modification alone, 11 semester-credit-hours were administratively removed from the curriculum. The revisions of the old curricula started at the beginning of the 1996-1997 academic year, and had to be ready for implementation in the fall of 1998.

The CET faculty was charged to make changes to the curriculum that satisfy the requirements of the Board of Regents, while maintaining the quality of the program that meets the needs of the industry. In order to achieve that goal, a survey was prepared and presented to the Industry Advisory Committee. The results of this survey showed that approximately 80% of the committee's members expect that the graduates of the CET program should be knowledgeable in the following areas of environmental engineering: water treatment, sanitary and industrial wastewater treatment, solid waste disposal practices and landfill design, and pollution control systems for non-mobile sources.

To understand the changes introduced to the curriculum, it is necessary to start the discussion listing the environmental engineering courses offered in the quarter system. The subsequent section discusses the specific changes introduced to the environmental engineering area of the CET program.

Civil Engineering Technology Curriculum in Quarter System

The civil engineering technology curriculum offered the student the opportunity of electing one of four specialty areas in environmental control, structures, surveying and transportation, or a general path with no particular specialization [1]. This program required 19 credit hours of elective courses to satisfy the degree requirements. For the environmental control area the CET department offered 27 credit hours of elective courses and 4 hours of a required course as shown below:

Course Name	*Credit hours*
Introduction to Environmental Engineering Technology (required)	4
Environmental Chemistry	4
Unit Operations in Environmental Engineering I	4
Unit Operations in Environmental Engineering II	4
Solid Waste Management	4
Industrial/Hazardous Waste Treatment	4
Urban Drainage and Erosion Control	4
Air Pollution Control	3

The first two courses of the environmental control sequence were designed to provide the student the basic understanding of the different areas studied in environmental engineering, as well as the basic chemistry concepts used to determine degrees of contamination and to develop treatment alternatives. The other courses of the sequence studied in more detail environmental problems, their causes and solutions according to the phase or phases affected.

Civil Engineering Technology Curriculum in Semester System

The major impact of the reduction on the total credit hours was the elimination of specialty areas. Currently, a student must take a minimum of 12 CET electives in addition to the required courses to satisfy the graduation requirements [2]. In order to provide flexibility to the students and to maintain the quality of the program, it was necessary to modify the contents of the courses and redefine the learning outcomes. As a result, four courses in the environmental engineering area were combined into two, while maintaining there additional elective courses, as shown below:

Course Name	*Credit hours*
Fundamentals of Environmental Engineering Technology (required)	4
Unit Operations in Environmental Engineering	4
Solid Waste Management	4
Industrial/Hazardous Waste Treatment	4
Air Pollution Control	3

The new Fundamentals of Environmental Engineering Technology course contains elements from the following courses of the quarter system: environmental chemistry, and unit operations in environmental engineering I and II. The concepts on environmental chemistry covered in this course are limited to acid-base equilibrium, precipitation and solubility products, and represent approximately 13% of the total instructional time. The study of water treatment processes and water distribution systems represents approximately 36% of the instructional time, while the remainder of the course is dedicated to wastewater collection and treatment systems. An effort has been made to include topics on treatment alternatives for small community systems. In addition to the direct instructional time, the students are exposed to basic laboratory analysis and techniques used in water and wastewater treatment. The proposed contents for this course is presented in Table 1.

At the end of the Fundamentals of Environmental Engineering Technology course, the student should be able to:

- identify the most important regulations concerning water quality
- understand the objectives of water and wastewater treatment
- size major components of conventional water treatment systems
- size major components of conventional activated sludge plants
- understand criteria used to design distribution systems
- design major components of sanitary sewer systems

The Unit Operations in Environmental Engineering course has been redesigned to provide information on and design criteria for processes such as biological nutrient removal and anaerobic treatment; physico-chemical removal of dissolved material, gas stripping, ion exchange and carbon adsorption: and sludge dewatering and disposal. Similarly to the Fundamentals in Environmental Engineering Technology course, the students are exposed to basic laboratory analysis and techniques used in water and wastewater treatment, in addition to the direct instructional time. The proposed contents of this course is presented in Table 2.

The following learning outcomes have been identified as the educational goals for the unit operations course:

- interpretation of water and wastewater analytical results
- understanding of the need for advanced or tertiary treatment for water and wastewater
- development of preliminary design of physical treatment processes (air stripping, carbon adsorption and ion exchange systems)
- development of preliminary design of nutrient removal systems

The contents of the remaining environmental courses have not been modified, because they were not drastically impacted by the curriculum modifications; with the exception of the Urban Drainage and Erosion Control course (quarter system), which was partially integrated with Applied Hydrology. However, the number of time these courses are offered during the year may diminish, due to the reduction of the number of elective courses to obtain the degree.

Table 1. Contents of the Fundamentals of Environmental Engineering Technology Course

Class No.	Topic
1	Introduction
2	Methods of Expressing Concentration
3	Chemical Equilibrium
4	Chemical Equilibrium
5	Acid-base Equilibrium
6	Acid-base Equilibrium - pH Calculations
7	pH Buffers and Buffer Capacity
8	Water Quality: Definitions, Regulations: Safe Drinking Water Act
9	Water Quality: Regulations - Clean Water Act
10	Water Quality: Regulations - Combined Sewer Overflows
11	Water Quality: Regulations - Wetlands
12	EXAM I
13	Water Treatment: Screening
14	Water Treatment: Flocculation and Coagulation
15	Water Treatment: Flocculation and Coagulation
16	Water Treatment: Sedimentation
17	Water Treatment: Sedimentation
18	Water Treatment: Filtration
19	Water Treatment: Disinfection
20	EXAM II
21	Wastewater Treatment: Grit Removal
22	Wastewater Treatment: Biological Growth - Nutrient Requirements
23	Wastewater Treatment: Activated Sludge
24	Wastewater Treatment: Activated Sludge
25	Wastewater Treatment: Activated Sludge
26	Wastewater Treatment: Sludge Handling - Digestion and Thickening
27	Wastewater Treatment: Sludge Handling - Dewatering
28	Wastewater Treatment: Disinfection
29	EXAM II
30	Water Distribution Systems: Methods of Distribution, Capacity and Pressure
31	Water Distribution Systems: Distribution Reservoirs
32	Water Distribution Systems: Types of Distribution Systems and System Components
33	Wastewater Collection: Types of Collection Systems, Types of Sewers
34	Wastewater Collection: Basic Sewer Design Considerations
35	Wastewater Collection: Design of Sanitary Sewers
36	Wastewater Collection: Design of Sanitary Sewers
37	Small Community Systems: Water Treatment Systems - Water Softening
38	Small Community Systems: Water Treatment Systems - Iron and Manganese Removal
39	Small Community Systems: Water Treatment Systems - Aeration
40	Small Community Systems: Wastewater Treatment Systems - Septic Tanks
41	Small Community Systems: Wastewater Treatment Systems - Stabilization Lagoons
42	Small Community Systems: Wastewater Treatment Systems - Stabilization Lagoons
43	Small Community Systems: Wastewater Treatment Systems - Trickling Filters
44	Small Community Systems: Wastewater Treatment Systems - Land Application
45	Small Community Systems: Wastewater Treatment Systems - Land Application
46	FINAL EXAM

Table 2. Contents of the Unit Operations in Environmental Engineering Course

Class No.	Topic
1	Introduction
2	Chemical Water Quality Parameters
3	Chemical Water Quality Parameters
4	Physico-chemical Removal of Dissolved Materials: Gas stripping
5	Gas stripping
6	Gas stripping
7	Gas stripping
8	Physico-chemical Removal of Dissolved Materials: Ion Exchange
9	Ion Exchange
10	Physico-chemical Removal of Dissolved Materials: Carbon Adsorption
11	Carbon Adsorption
12	Carbon Adsorption
13	EXAM I
14	Physico-chemical Removal of Dissolved Materials: Membrane Processes
15	Membrane Processes
16	Membrane Processes
17	Biological Removal of Dissolved Materials: Nutrient Removal
18	Nutrient Removal
19	Nutrient Removal
20	Nutrient Removal
21	Nutrient Removal
22	EXAM II
23	Biological Removal of Dissolved Materials: Anaerobic Treatment
24	Anaerobic Treatment
25	Anaerobic Treatment
26	Anaerobic Treatment
27	Anaerobic Treatment
28	Anaerobic Treatment
29	Anaerobic Treatment
30	Sludge Management and Disposal: Sludge Dewatering
31	Sludge Dewatering
32	Sludge Dewatering
33	Sludge Stabilization
34	Sludge Stabilization
35	Sludge Stabilization
36	EXAM III
37	Sludge Disposal
38	Sludge Disposal
39	Sludge Disposal
40	Sludge Disposal
41	Ancillary Systems: Polymer Addition
42	Lime Addition System
43	Lime Addition System
44	Other Chemical Addition Systems
45	Other Chemical Addition Systems
46	PROJECT PRESENTATION

The proposed syllabi presented in this document are currently being tested, and would be evaluated within a year to assess their effectiveness in achieving the specific learning outcomes outlined for each of the courses. Specific forms, without a grade value that could influence the evaluation, are currently being prepared to assess learning outcomes.

Bibliography

1. Southern College of Technology. General Catalog, 1996-1998. Marietta, Georgia.
2. Southern Polytechnic State University. General Catalog, 1998-1999. Marietta, Georgia

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