CE 453

Course Syllabus

Fall 2012

Part I Course Organization

CE 453
Water Quality Control
Fall 2012

Catalogue Description:

CE 453 - Water Quality Control. Water quality criteria and fundamentals of acceptability. Natural purification of surface waters. Processes employed in the treatment of water and wastewater.

Goals:

This course is designed for junior/senior undergraduate's students (also for first year graduate students lacking the required background) in Civil and Environmental Engineering to learn the fundamentals of water quality and distribution systems, wastewater collection systems, water and wastewater treatment technologies and design strategies.

Instructor

Ali A. Karimi, Ph.D., P.E., DEE

E-Mail: aakarimi@usc.edu

Class Time: Wednesday, 6:30 to 9:10 pm
Class Location: SLH100

Teaching Assistant: Woonhoe Kim "Kim"
E-Mail: woonhoek@usc.edu
Office Hour: Tuesday, 1:00 to 3:00, KAP239
Discussion: Tuesday, 3:30 to 4:20, SGM601
Wednesday, 4 to 4:50, KAP145

Field Trips

1. Tour of the Los Angeles Aqueduct Filtration Plant- Date: TBD
2. Tour of Hyperion Wastewater Treatment Plant or Tillman Wastewater Treatment Plant- Date: TBD

Grading Criteria

Mid-Term:	30%
Homework Assignments:	15%
Term project:	15%
Final:	40%
	100%

Text Book

Hammer, M.J., and Hammer, M.J., Jr., "**Water and Wastewater Technology**," 7th Edition, Prentice- Hall, Inc., Englewood Cliffs, New Jersey, 2012.

Class Schedule

Session	Date	Event
1	08/29	
2	09/5	
3	09/12	
4	09/19	**Group formation sign up sheet**
5	09/26	**Formation of Term Project groups**
6	10/3	
7	10/10	
8	10/17	
9	10/24	
10	10/31	**Mid-Term Exam**
11	11/07	
12	11/14	
13	11/21	
14	11/28	
15	12/5	**Term Project Presentation**
16	12/12	**Final Exam** (7:00 to 9:00pm)

CE 453: WATER QUALITY CONTROL Fall 2012

Course Syllabus

1. BACKGROUND: WATER CHEMISTRY (2 weeks)

Elements, radicals, and compounds
Chemical water analysis
Hydrogen ion concentration and pH
Chemical equilibria
Chemical kinetics Gas
solubility Alkalinity
Colloids and coagulation
Organic compounds
Organic matter in wastewater
Laboratory chemical analyses

2. WATER MICROBIOLOGY (2 weeks)

Bacteria and fungi
Viruses
Algae
Protozoa and multicellular animals
Aquatic food chain
Waterborne diseases
Coliform bacteria as indicator organisms
Tests for the coliform group
Testing for enteric viruses
Biochemical oxygen demand
Biological treatment systems

3. HYDRAULICS and HYDROLOGY (3 weeks)

Water pressure
Pressure-velocity-head relationships
Flow in pipes under pressure
Centrifugal pump characteristics
System characteristics
Equivalent pipes
Gravity flow in circular pipes
Flow measurement in pipes, and open channels
Amount of storm runoff
Flow in streams and rivers
Hydrology of lakes and reservoirs
Groundwater hydrology

4. WATER QUALITY and POLLUTION (1 week)

Quality of surface waters
Water quality in flowing waters
Water quality in impounded waters
Groundwater quality

Water quality standards
Microbiological quality of drinking water
Chemical quality of drinking water

5. WATER DISTRIBUTION SYSTEMS and WATER TREATMENT(3 weeks)

Water quality and pressure requirements
Municipal fire protection requirements
Surface-water intakes
Mixing and flocculation
Sedimentation
Flocculator-clarifiers
Filtration
Turbidity removal
Taste and odor control
Synthetic organic chemical removal
Iron and manganese removal
Precipitation Softening
Fluoridation
Chlorination
Chlorination by-products
Ozone
Disinfection
Ion exchange softening and nitrate removal
Removal of dissolved salts
Sources of wastes in water treatment
Dewatering and disposal of wastes from water treatment plants

6. WASTEWATER FLOWS, CHARACTERISTICS AND TREATMENT (3 weeks)

Domestic wastewater
Industrial wastewater
Infiltration and inflow
Considerations in plant design
Preliminary treatment
Pumping stations
Clarification
Biological filtration
Rotating biological contactors
Biological aeration
Stabilization ponds
Effluent disinfection
Individual household disposal systems
Characteristics and quantities of waste sludges
Selection and arrangement of sludge processes
Gravity sludge thickening
Thickening of waste activated sludges
Anaerobic digestion
Aerobic digestion
Pressure filtration
Centrifugation

Composting
Agricultural land application
Incineration and drying
Odor control

Term Project

Students are required to form a team (consisting of 3 to 4 students) by September 26, 2012 to work collectively on a design project. The credit for the term project will constitute 15% of the final semester grade.
The term project will consist of design of a treatment facility.

A 10 minute PowerPoint presentation on the term project is mandatory. Student presentations will be made in the class on Dec. 5, 2012. A sign up sheet will be passed around in the class on September 19, 2012.

Statement for Students with Disabilities

Any student requesting academic accommodation based on disability is required to register with Disability Services and Programs Office (DSPO) each semester. A letter of verification for approved accommodations can be obtained from DSPO. Please be sure the letter is delivered to the instructor (or the TA) as early in semester as possible. DSPO is located in STU 301 and is open 8:30am – 5:00pm, Monday through Friday. The phone number for DSPO is (213) 740- 0776. (This statement is suggested by the office of the Provost).

Statement on Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. *Scampus,* the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: http://www.usc.edu/dept/publications/SCAMPUS/gov/. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: http://www.usc.edu/student-affairs/SJACS/.

Part II Detailed Course Objectives

CE 453 ENE Water Quality Control 3 Units

USC | SONNY ASTANI DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

ABET Course Syllabus

Course Information, Textbook, and Supplementary Materials

Course Description: Water Quality Control. Water quality criteria and fundamentals of acceptability. Natural purification of surface waters. Processes employed in the treatment of water and wastewater.

Required for: BSCE, BSCE-ENE and BSENE **Elective for**: BSCE Building Science

Prerequisites: 1 from CHEM 105aL General Chemistry or CHEM 115aL Advanced General Chemistry

2 Co-Requisites: 1 from CE 408 Risk Analysis in Civil Engineering or CHE 405 Applications of Probability and Statistics for Chemical Engineers; **and 1 from** CE 309 Fluid Mechanics or ENE 410 Environmental Fluid Mechanics

Note: CE 309 and ENE 410 have duplicate credit

Required Textbook: Hammer, M. J., and Hammer, M. J., Jr., *Water and Wastewater Technology*, 5th edition, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 2004.

Reference: Class Notes for CE 453 adapted by Professor Mike Pirbazari

Topics Covered	Learning Outcomes
Background of Water Chemistry	Students will learn the fundamentals of water quality, distribution systems, collection systems, and water as well as wastewater treatment and technologies, as follows: 1. Elements, radicals, and compounds, Chemical water analysis, Hydrogen ion concentration and pH, Chemical equilibria, Chemical kinetics, Gas solubility, Alkalinity, Colloids and coagulation, Organic compounds, Organic matter in wastewater, and Laboratory chemical analyses
Water Microbiology	2. Bacteria and fungi, Viruses, Algae, Protozoa and multi-cellular animals, Aquatic food chain, Waterborne diseases, Coliform bacteria as indicator organisms, Tests for the coliform group, Testing for enteric viruses, Biochemical oxygen demand, and Biological treatment systems
Hydraulics and Hydrology	3. Water pressure, Pressure-velocity-head relationships, Flow in pipes under pressure, Centrifugal pump characteristics, System characteristics, Equivalent pipes, Gravity flow in circular pipes, Flow measurement in pipes, and open channels, Amount of storm runoff, Flow in streams and rivers, Hydrology of lakes and reservoirs, and Groundwater hydrology
Water Quality and Pollution	4. Quality of surface waters, Water quality in flowing waters, Water quality in impounded waters, Groundwater quality, Water quality standards, Microbiological quality of drinking water, and Chemical quality of drinking water
Water Distribution Systems and Water Treatment	5. Water quality and pressure requirements, Municipal fire protection requirements, Surface-water intakes, Mixing and flocculation, Sedimentation, Flocculator-clarifiers, Filtration, Turbidity removal, Taste and odor control, Synthetic organic chemical removal, Iron and manganese removal, Precipitation softening, Fluoridation, Chlorination, Chlorination by-products, Ozone, Disinfection, Ion exchange softening and nitrate removal, Removal of dissolved salts, Sources of wastes in water treatment, and Dewatering and disposal of wastes from water treatment plants

Wastewater flows, characteristics and treatment	6. Domestic wastewater, Industrial wastewater, Infiltration and inflow, Considerations in plant design, Preliminary treatment, Pumping stations, Clarification, Biological filtration, Rotating biological contactors, Biological aeration, Stabilization ponds, Effluent disinfection, Individual household disposal systems, Characteristics and quantities of waste sludge, Selection and arrangement of sludge processes, Gravity sludge thickening, Thickening of waste activated sludge, Anaerobic digestion, Aerobic digestion, Pressure filtration, Centrifugation, Composting, Agricultural land application, Incineration and drying, and Odor control

Lecture and Lab Schedule

Lecture		Lab	
Sessions per Week	Duration per Session	Sessions per Week	Duration per Session
1	3 hours	n/a	

Contribution of Course to Meeting the Professional Component

Engineering Topics

Water Quality Control. Water quality criteria and fundamentals of acceptability. Natural purification of surface waters. Processes employed in the treatment of water and wastewater.

Engineering Topics | Other

Constraints and Considerations. Students will understand the diverse constraints and considerations that are representative of what they will encounter in an engineering practice. This course covers the following topics:

Economic | Environmental | Sustainability | Manufacturability | Health and Safety | Social | Political | Energy

Relation of Course, Objectives to Program Outcomes

The Civil Engineering program is designed to teach beyond the technical content of the curriculum and prepare the students to utilize what they learn in a professional setting.

This course contributes to the program outcomes as outlined in the adjacent table.

Course Contribution to Program Outcomes *(a-k)*	✓ Key
a. An ability to apply knowledge of mathematics, science, and engineering.	
c. An ability to design a system component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.	
e. An ability to identify, formulate and solve engineering problems.	
h. The broad education necessary to understand the impact of engineering solutions in a global economic and environmental and societal context.	
i. Recognition of the need for, and an ability to engage in life-long learning.	
j. Knowledge of contemporary issues.	
k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	

Prepared by: Dr. Ali A. Karimi **Date:** Fall 2012