CE 463L ENE Water Chemistry and Analysis 3 Units

USC | SONNY ASTANI DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

ABET Course Syllabus

Course Information, Textbook and Supplementary Materials

Course Description: Chemistry of water purification technology and water pollution control. Chemical processes in natural and engineering aquatic environments; physical/chemical and biological characterization of water and wastewater.

Required for: BSCE-ENE and BSENE

Prerequisites: CE 453; and 1 from CHEM-105b or CHEM 115b

Co-Requisite: None

Required Textbooks:

1. Snoeyink, V.L. and Jenkins, D.W. Water Chemistry, John Wiley & Sons, New York, 1980.
2. Jenkins, D.W., Snoeyink, V.L., Ferguson, J.H., and Leckie, J.O. *Water Chemistry: Laboratory Manual,* 3rd edition, John Wiley & Sons, New York, 1980.
3. Class Notes for CE 463L: *Water Chemistry and Analysis*, Lectures and Laboratory Experiments; adapted by Professor Mike Pirbazari, Spring 2007.

References:

Sawyer, C. N. and McCarty, P. L. *Chemistry for Environmental Engineering*, 5th edition, McGraw-Hill, New York, 2002.

Standard Methods for the Examination of Water and Wastewater, 21st edition, APHA, AWWA and WPCF, Washington, D.C., 2005.

Topics Covered	Learning Outcomes
Introduction to Water Chemistry	Students will learn: 1. General Properties of Water, Composition of Different Waters, and Methods of Expressing Concentrations
Chemical Equilibrium	2. Thermodynamic Basis of Chemical Equilibrium, Enthalpy, Free Energy, and Equilibrium Constant, and Non-ideal Behavior of Ions and Molecules in Solution
Chemical Kinetics	3. Reaction Mechanism, Reaction Rate Laws, Temperature Effect on Reaction Rates, Catalysis, and Empirical Rate Laws
Acid-Base Chemistry	4. Equilibrium Calculations — General Approaches, Mass Balance, Charge Balance, and Proton Condition, Equilibrium Relationships, Graphical Techniques for Equilibrium Calculations, Effects of Temperature and Ionic Strength on Equilibria, Mixtures of Acids and Base Calculations for pH Determination, pH Buffers and Buffer Intensity, Carbonate System and Its Equilibria, Alkalinity and Acidity, and Theory of Acid-Base Titration
Precipitation and Dissolution	5. Precipitation and Dissolution Kinetics, Equilibria of Dissolution, Solubility Product Concept, Temperature Effect on Solubility, Common Ion Effect, Complexation and Solubility, Solubility of Salts, Solubility Phase Diagrams and Their Applications, Ferrous and Ferric Carbonates and Hydroxides, and Theoretical Aspects of Precipitation

Oxidation-Reduction Reactions	6. Redox Stoichiometry and Equilibria, Free Energy and Potential Half Reactions, Electrode Potential and the Nernst Equation, Electron Activity Concept, Equilibrium Calculations, Graphical Representation of Redox Equilibria, Applications of pe^-C and pe^-H Diagrams, Theories of Corrosion, Application of the Galvanic Cell Concept, Corrosion Control, Iron Chemistry and Acid Mine Drainage, and Biologically Important Redox Reactions

CE 463L ENE Water Chemistry and Analysis 3 Units

USC | SONNY ASTANI DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Lecture and Lab Schedule			
Lecture		**Lab**	
Sessions per Week	Duration per Session	Sessions per Week	Duration per Session
1	1.5 hours	1	2 hours

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.	
b. An ability to design and conduct experiments, as well as to analyze and interpret data.	✓
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. Mike Pirbazari
Professor of Environmental Engineering

Date: Fall 2014