College of Engineering

Department of Civil Engineering

CE 506 Environmental Chemistry

Credit and Contact hours	3/ 3 (Lectures), 0 (Tutorials), 0 (Laboratory)
Required, or Elective	Required for a MSCE degree
Course Description	The course provides comprehensive coverage of the chemistry of natural and polluted waters and on the applied chemistry of water and wastewater treatment. The course covers dilute aqueous solution chemistry of acid-base reactions, chemical kinetics, equilibrium principles, complex formation, precipitation and dissolution reactions, and oxidation-reduction reactions. These fundamental chemical principles are applied to the natural and polluted water, water, and wastewater treatment processes.
Prerequisites or Co-requisites	1-This is an advanced graduate level course in environmental chemistry, and thus, students are required to have: (1) taken at least one undergraduate course in general chemistry (2) taken at least one undergraduate course in physics; (3) comfort with doing some math. 2- Under graduate courses CE 443 Water and Wastewater Laboratory, and CE 448 Water and Wastewater Treatment
Course Learning Outcomes	Students completing this course successfully will be able to

Course Learning Outcomes	***Related Program Outcomes***
CLO1: Understand the basic properties of water and how these properties influence its role in the environment.	**K1**
CLO2: Recognize general composition of several types of waters and wastewaters before applying physicochemical processes in water.	**K1**
CLO3: Gain knowledge for mass concentrations, chemical kinetics, chemical equilibrium, topics of acid-base chemistry, redox reactions and coordination chemistry of complexes.	**K1**
CLO4: Conduct water chemistry-related experiments according to established procedures, as well as analyze and evaluate the results	**S1**

	CLO5: Apply chemical principles techniques to identify, analyze, develop, and solve advanced water and wastewater treatment problems. — **S1** **CLO6**: Interpret oxidation/reduction reactions and precipitation/dissolution of minerals and amorphous solids in waters, and predict equilibrium tendencies. — **C2**
Student Outcomes related to this Course	**K1**. Recognize advanced engineering knowledge, concepts and techniques to identify, interpret and analyze complex and real-life engineering problems. **S1**. Provide solution for complex and real-life engineering problems through critical thinking and using modern engineering tools and identify its impact on social and ethical issues. **C2**. Design novel advanced Civil Engineering systems and evaluate its performance and effectiveness for engineering practice and its impact on society.
Topics Covered	

List of Topics	Related CLOs
1. Introduction and review of general chemistry, properties of water, typical water composition and methods of expressing concentration.	CLO1
2. Chemical kinetics: Rate expressions, effects of temperature and catalysis, empirical expressions	CLO3
3. Chemical equilibrium: Thermodynamic basis for equilibrium, temperature effects, non-ideal behavior.	CLO2
4. Acid-base chemistry: Equilibrium calculations, acid-base systems, carbonate system, alkalinity.	CLO3
5. Coordination chemistry: Complexation stability and equilibrium calculations, metal hydrolysis	CLO4
6. Precipitation and dissolution: Solubility calculations, effects of complexation, carbonate solubility	CLO5
7. Oxidation-reduction reactions: Redox equilibrium calculations, redox characteristics of groundwaters.	CLO6

Textbook(s) and Other Required Material	1- Vernon L. Snoeyink (1980) Water chemistry, New York: Wiley. 2- Chemistry for Environmental Engineering and Science (5th Ed.), Sawyer, McCarty and Parkin. McGraw-Hill, 2003.
Grading System	Assignments 20% Laboratory Experiments and Reports 20% Midterm Exam 20% Final Exam 40%
Instructors	Prof. Ashraf Refaat, Office 2A4, refaat@ksu.edu.sa
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