College of Engineering Department of Civil Engineering



CE 508 Physicochemical Treatment Processes

Credit and Contact hours	3 / 3 (Lectures), 0 (Tutorials), 0 (Laboratory)		
Required, or Elective	Required		
Course Description	Fundamentals of process kinetics and reactor engineering. Aeration and gas transfer, coagulation and flocculation, sedimentation, filtration, and disinfection. Adsorption, ion exchange and membrane processes. Chemical sludge treatment and handling.		
Prerequisites or Co- requisites	CE 448 Water and Wastewater Treatment, and CE 443 Water and Wastewater Laboratory		
Course Learning Outcomes	Students completing this course successfully will be able to:		
	Course Learning Outcomes (CLOs)	Related Student Outcomes (SO)	
	CLO1. Review basic engineering principles for Water Quality Parameters - Physical and chemical properties of targeted pollutants and reaction kinetics. K1	SO1	
	CLO2. Understanding the theory and kinetics of Engineering Reactors. K1	SO1	
	CLO3. Design the physical unit operations and processes for water and wastewater treatment. S4	SO5	
	CLO4. Design the chemical unit operations and processes for water and wastewater treatment. S4	SO5	
	CLO5. Design of advanced physical and chemical treatment processes. S4	SO 5	
Student Outcomes related to this Course	 SO 1 Recognize advanced engineering knowledge, concepts, and techniques to identify, interpret, and analyze complex and real-life engineering problems. SO 5 Design novel advanced Civil Engineering systems and evaluate their performance, sustainability, and effectiveness for engineering practice and their impact in global, economic, environmental, and societal contexts 		

	List of Topics	Related CLOs
	 Introduction to Physical/Chemical Water wastewater Treatment Processes: objectives of water treatment, water sources, water contaminants, overview of methods used to treat water/wastewater. 	CLO 1,3,4
	2. Reactor engineering: Reactors Used for the Treatment of Wastewater, Mass transport processes, The Mass-Balance Principle, Reaction's kinetics and reaction rates, Configurations of ideal and non-ideal reactors, Principle of ideal reactor design, completely mixed batch reactors, completely mixed flow reactors, Determination of rate parameters in CMF reactors, Plug Flow Reactors.	CLO 1,2
	3. Chemical precipitation and coagulation: particle destabilization, hydrolysing metals, polymers, mechanisms, jar tests, enhanced coagulation	CLO 4
	4. Flocculation and Mixing: basics, theory, practice.	CLO 4
Topics Covered	 Sedimentation: discrete particle behavior, flocculent settling, sedimentation tank types and Design of sedimentation clarifiers. 	CLO 3
	6. Filtration: history, hydraulics, particle capture mechanisms, types of filters and design.	CLO 3
	 Disinfection: pathogens, disinfectants, inactivation kinetics, CT concept, reactors, regulations, disinfection by-products and different types of disinfection processes 	CLO 2,4
	 Gas transfer and aeration: removal of dissolved gases (degasification), Gravity Aerators, Spray Aerators, Diffused Air Aeration Systems and Mechanical Aerators 	CLO 2,4
	 Adsorption processes: types of adsorptions, factors influencing, adsorption equilibrium and development of adsorption isotherms, activated carbon adsorption kinetics, analysis and design of Granular Activated carbon and PAC contactors 	CLO 2,4,5
	 Ion Exchange: softening, demineralization, Exchange processes, Exchange Materials, Synthetic Exchange resins, Exchange reaction, Equilibria, Exchange Isotherm 	CLO 2,4
	 Membrane Processes: microfiltration, ultrafiltration, nanofiltration, reverse osmosis, forward osmosis, fouling 	CLO 3,5
	12. Chemical Oxidation: Limitation of Oxidative Processes and Oxidizing agents in Water and Wastewater Treatment, Principle and Theories of Chemical Oxidation, Concept and definition	CLO 2,4,5
Textbook(s) and Other Required Material	• Water Treatment: Principles and Design, 3rd ed., John Wiley &	Sons.

Grading System	Assignments	20%	
	Lecture Attendance		
	Project work	20%	
	Mid-term exams	20 %	
	Final Exam	40 %	
Instructors	Dr. Omar A. Alrehaili / Dr. Mohab Amin Amin		
Date of Review	March, 2025		