

ENE 890 Selected Topics in Environmental Engineering
Electrified Water Treatment

Lecture:	Tuesday	10:20-11:40 AM	Wells Hall A302
	Thursday	10:20-11:40 AM	Wells Hall A302

• **Instructor:**

Shiqiang (Nick) Zou, Ph.D.

Assistant Professor of Environmental Engineering

Department of Civil and Environmental Engineering

428 S Shaw Ln Rm 3559

Engineering Building

Telephone: +1 (517) 353-1743

Email: zoushiqi@msu.edu

• **Course Description**

Traditional water treatment relies on physical, chemical, and biological processes to purify water. These processes require continuous chemical addition, periodic maintenance, large energy input, and generate huge amounts of solid waste. With the rapid development of electrochemistry knowledge, we start looking into electrified water treatment processes for an autonomous, precise, resilient, intensified, modular, and electrified water treatment towards a circular water economy (i.e., A-PRIME C from National Alliance for Water Innovation). The goal of this class is to help you understand both the fundamentals of electrochemistry and its engineering application in water treatment. In this class, you will learn fundamental electrochemistry concepts (e.g., anode, cathode, potential, voltage, electrons, and redox reactions), electrochemical analytical techniques (e.g., voltammetry and amperometry), electrochemical water treatment processes (e.g., electrooxidation, electroreduction, electrodialysis, etc.) and case studies in electrified water treatment covered by invited speakers from industries. We will also perform in-class demonstrations to help you connect classroom knowledge with hands-on engineering practices.

• **Textbooks**

- Bard, Faulkner & White. Electrochemical Methods: Fundamentals and Applications (3rd Edition)
- Sillanpaa & Shestakova. Electrochemical Water Treatment Methods (2017).

• **Evaluation**

Grading Rubric (Tentative)

	Percentage
Homework	20%
Reading Quiz	20%
Midterm Exam	20%
Final Project	20%
Project Presentation	20%
Project Report	20%

Total

100%

• **Course Schedule (Tentative)**

Lecture Dates	Approximate weekly topics	Topic(s)
Week 1	Course Intro	Topic 0
Week 2	Fundamentals and Terminology	Topic 1
Week 3	Interfacial Phenomena and Charging Current	Topic 2
Week 4	Faradaic Process and Mass Transfer	Topic 3
Week 5	Thermodynamics and Kinetics	Topic 4
Week 6	Potential Steps	Topic 5
Week 7	Linear Sweep and Cyclic Voltammetry	Topic 6
Week 8	Electrochemical Impedance Spectroscopy	Topic 7
Week 8	Midterm Exam	In Class
Week 9	Spring Break	No Class
Week 10	Electro-oxidation (EO)	Topic 8
Week 11	Electro-reduction (ER)	Topic 9
Week 12	Electro-coagulation (EC)	Topic 10
Week 13	Electrodialysis (ED)	Topic 11
Week 14	Capacitive Deionization (CDI)	Topic 12
Week 15	Electrified Membrane	Topic 13
Week 16	Electrified Resource Recovery	Topic 14
Week 17	Final Project Presentation	In Class