CEE 597T – Electrochemical Water and Wastewater Treatment
Spring Semester 2019

Course Description:	CEE 597T: Electrochemical Water and Wastewater Treatment. Credit 1. Basic Concepts in Electrochemistry; Electrocoagulation: reactions, electrode materials used in electrocoagulation, electro-Fenton methods, applications in water and wastewater treatment, an experiment in the lab.; Electrochemical oxidation: indirect electrochemical oxidation, direct electrochemical oxidation, electrode materials, electrochemical oxidation of organic compounds, electrochemical oxidation of inorganic compounds, electrochemical disinfection, applications in water and wastewater treatments, an experiment in the lab.; Electrochemical Reduction: electrochemical reduction of metals, electrochemical reduction of inorganic and organic nitrogen compounds; Electroflotation: principles; Electrodialysis: principles, main calculations, parameters; Microbial Fuel Cells: working principles of microbial fuel cells Basic concepts in electrochemistry, applications for treatment of drinking water, wastewater, with possible water reuse as an objective. Includes applications in the form of . Prerequisite: Chm 112.

Prerequisites by Topic:

1. Chem 112: Basic understanding of chemistry, chemical stoichiometry, and chemical reactions.

Schedule: W 12:20

Textbook: none Required

Instructor:	David A. Reckhow, 16c Marston or 3rd floor Elab II, reckhow@umass.edu office hours: MWF 9:30-11:00AM or as posted Umran Tezcan Un, 240 Mullins Way ELab III, utezcanun@umass.edu Office hours: MWF 14:00-15:30

Objectives:

1. To become familiar with the basic concepts in electrochemistry: electrochemical phenomena, electrochemical cells, electrode potentials, Faraday's Laws;
2. To become accustomed to the electrochemical methods used in the treatment of water and wastewater;
3. To provide the students with the background necessary to use the current prevailing approach to treatment of water and wastewater
4. To understand how the operational parameters can effect the performance of the cell
5. To gain experiences of how electrochemical methods works and to be aware of potential problems involved in the working of a cell

Outcomes:	1. Ability to understand treatment mechanism of electrochemical methods and interpret reactions take place at the cathode, the anode and in the solution 2. Ability to apply and control techniques for the electrochemical removal of contaminants, such as organics and heavy metals 3. Ability to discuss advantage and disadvantage of the electrochemical methods in groups 4. Ability to apply some common electrochemical methods to electrochemical systems and explain which type of information that can be obtained with these techniques 5. Ability to explain the practical usage of electrochemical technology in our life

Outcome Measures and Assessment:	1. During class, students are expected to participate in class discussions 2. Students will review a journal articles on two of the topics. Each student will be responsible for compiling a brief (maximum three page) summary to include a brief summary of your assigned articles and information from another source (text, journal, website, etc.) that concurs or disagrees with the authors of your assigned articles. 3. Each student will be responsible for locating and sharing one example from application of electrochemical methods in the field. Be prepared to share briefly and discuss relevance of your find to class objectives. 4. Each student will prepare a review paper on an assigned topic and present in the class. Your paper should include the following sections: a. A short introduction b.Theory c.Applications d. Conclusion

Grading Criteria: (attendance is required)

Article Review 1	20%
Article Review 2	20%
A class presentation of application examples	20%
Writing review paper	40%
	100%

References:

1. Carlos Alberto Martínez-Huitle, Manuel A Rodrigo, Onofrio Scialdone (Eds), Electrochemical Water and Wastewater Treatment, 1st Edition, Elsevier, 2018
2. Mika Sillanpää, Marina Shestakova, Electrochemical Water Treatment Methods, 1st Ed., Elsevier, 2017
3. Keith Scott, Eileen Hao Yu, Microbial electrochemical and fuel cell fundamentals and applications, Elsevier, 2015
4. Bui, X.-T., Chiemchaisri, C., Fujioka, T., Varjani, S. (Eds.), Water and Wastewater Treatment Technologies, Springer, 2019
5. Allen J. Bard, Larry R. Faulkner, Electrochemical Methods:Fundamentals and Applications, Second Ed., John Wiley&Sons. Inc., 2001
6. Christos Comninellis, Guohua Chen (Eds), Electrochemistry for the Environment, Springer, 2010
7. Keith B. Oldham, Jan C. Myland, Alan M. Bond, Electrochemical Science and Technology, Fundamentals and Applications, Wiley, 2012.

8. O'Brien, Thomas F., Bommaraju, Tilak V., Hine, Fumio, Handbook of Chlor-Alkali Technology, Springer, 2005

TOPICS:	Chapters in:							
	Ref 1	Ref 2	Ref3	Ref4	Ref5	Ref6	Ref 7	Ref8
1. Basic Concepts in electrochemistry		1			1		3,6,7, 10,13	4 &5
2. Electrocoagulation reactions, electrode materials used in electrocoagulation	3	2				10		
3. Electro-Fenton Methods, Applications in water and wastewater treatment	8	3		8				
4. An experiment:Electrocoagulation								
5. Electrochemical oxidation, direct and indirect electrochemical oxidation, electrode materials	6&7	2				9		
6. Electrochemical oxidation of organic and inorganic compounds		2				8		
7. Electrochemical disinfection, applications in water and wastewater treatments						6&7		15
8. An experiment in the laboratory: electrochemical oxidation								
9.Electrochemical Reduction: electrochemical reduction of metals, electrochemical reduction of inorganic and organic nitrogen compounds	1	2				12		
10.Electroflotation	4	2				11		
11. Electrodialysis: principles, main calculations, parameters		2						
12.Microbial Fuel Cells: working principles of microbial fuel cells	12	2	1-8					
13.Microbial Fuel Cells: application examples	12	2	8-12					

CEE 597T Website:

http://www.ecs.umass.edu/cee/reckhow/courses/Etreat/