


# CEE 597T ELECTROCHEMICAL WATER AND WASTEWATER TREATMENT



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## OBJECTIVES


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



## OUTCOMES

- Ability to understand treatment mechanism of electrochemical methods and interpret reactions take place at the cathode, the anode and in the solution
  - Ability to apply and control techniques for the electrochemical removal of contaminants, such as organics and heavy metals
  - Ability to discuss advantage and disadvantage of the electrochemical methods in groups
  - Ability to apply some common electrochemical methods to electrochemical systems and explain which type of information that can be obtained with these techniques
  - Ability to explain the practical usage of electrochemical technology in our life
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## OUTCOME MEASURES AND ASSESSMENT

- During class, students are expected to participate in class discussions
  - 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.
  - 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.
  - 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
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## GRADING CRITERIA

- Article Review 1 →20%
- Article Review 2 →20%
- A class presentation of application examples →20%
- Writing Review Paper →40%
- 100%



## TOPICS

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



## REFERENCES

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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

