

MATE 540 “Electrochemical Techniques & Processes” Fall 2017

Mon. Wed. Fri. 8:00 – 8:50 a.m. Cramer 124

Instructor: T. David Burleigh, Professor, Materials & Metallurgical Engineering

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Textbook: not assigned

Course Description:

This course is an overview of the growing field of electrochemistry, and the many electrochemical techniques and processes. The lectures and assignments will review the theory and the science of batteries, electroplating, fuel cells, electrocatalysis, electro-refining, corrosion, bioelectrochemistry, and organic electrosynthesis. In addition to the applications, the electrochemical techniques will also be introduced, including open circuit potentials, linear polarization, potentiodynamic polarization, cyclic voltammetry, zeta potentials, electrochemical impedance spectroscopy, and photoelectrochemistry.

Lectures, Homework & Exams:

Attending/watching the lectures and completing the homework assignments are essential for a good grade. The exams and quizzes will be based on my lectures and the homework. The homework assignments will be due on Mondays either in class or delivered to my office before 5:00 p.m. Later homework will be accepted but will be penalized 50%. You may discuss the homework with your fellow students, but the exams must be your work alone.

Canvas

The recorded lectures, white board notes, class handouts, lecture slides, and the solutions to the homework, quizzes and exams will be posted on <https://nmt.instructure.com>.

Electrochem Project, Report, and Presentation:

Each student will write a short report on their electrochemistry project. The report will describe their experiments and the theory and must be 6-8 pages in length with font size 12. The reports must contain figures, many references, and be very well written and fascinating to read. Each student will also present a 10-minute Powerpoint presentation to the class based on his or her report. If any part of your report is plagiarized, you will receive a zero for the report. Plagiarism is the use of another's words or ideas without giving proper credit to the source.

Grading:

Your final grade will be based on the following weighted distribution:

Homework	20%	Team Quizzes	20%
Exam #1	20%	Report	15%
Exam #2	20%	Presentation	5%

Final letter grades will be based on the following scale:

90-100% = A 80-89% = B 70-79% = C 60-69% = D <60% = F

I reserve the right to lower this scale to improve the grades, and assign pluses and minuses.

Lecture #	Date	Tentative Lecture Topics	Mostly due on Mondays:
1 2	8/21 8/23 8/25	<i>Solar Eclipse (no class)</i> Introduction & Historical Galvanic Corrosion	HW#1 (due 8/28) EMF, Galvanic
3 4 5	8/28 8/30 9/1	Cathodic Protection Electrochemical measurements Reference electrodes, Team Quiz #1	HW#2 (due 9/6) 9V experiments
6 7	9/4 9/6 9/8	<i>Labor Day (no class)</i> Techniques: OCP, LP, PDP, Tafel, Techniques: Cyclic Voltammetry, EIS,	HW#3 (due 9/11) calculations of R_p , I_{corr}
7 8 9	9/11 9/13 9/15	Photoelectrochemistry (PEC) Zeta Potential, Nernst Equation, OHP, Zero Miniaturized cells, Team Quiz #2	HW#4 (due 9/18) calculations of R_p , I_{corr}
10 11 12	9/18 9/20 9/22	pH electrodes, Ion-selective electrodes Batteries, historical	HW#5 (due 9/25) pH electrodes
13 14 15	9/25 9/27 9/29	Alkaline batteries Pb-acid, Zn-air, Lithium-ion, molten metal Flow Batteries, Team Quiz #3	HW#6 (due 10/2) Batteries
16 17 18	10/2 10/4 10/6	Fuel Cells, Chlor-Alkali Industry. Mg Molten Salt Electrolysis, Al, Zn	HW#7 (due 10/9) 1-page project summary due
19 20 21	10/9 10/11 10/13	Passivation Electroplating, Electrowinning Electropolishing	Exam #1 (due 10/16)
22 23	10/16 10/18 10/20	Anodization Dye Sensitized Solar Cells <i>49er's (no class)</i>	HW#8 (due 10/23) Electroplating
24 25 26	10/23 10/25 10/27	Bioelectrochemistry, EKG Electrodialysis Methanogens (Microbes), Team Quiz #4	HW#9 (due 10/30) Bioelectrochemistry
27 28 29	10/30 11/1 11/3	Electroorgano Chemistry Electrocoagulation Electropolymerization	HW#10 (due 11/6) Draft reports due
30 31 32	11/6 11/8 11/10	Electrocatalysis Atomic Layer Deposition Team Quiz #5	HW#11 (due 11/13) Electroorgano-Synthesis
33 34 35	11/13 11/15 11/17	Electrophoretic Deposition Cold Fusion, historical Cold Fusion, present	HW#12 (due 11/20) www.lenr-canr.org report
36 37	11/20 11/22 11/24	Electro-stripping of paints Team Quiz #6 <i>Thanksgiving Break (no class)</i>	Final Reports (due 11/27)
38 39 40	11/27 11/29 12/1	Student Presentations Student Presentations Student Presentations	
41 42 43	12/4 12/6 12/8	Student Presentations Student Presentations Special topics,	Exam #2 (due 12/11)