CE 597: ENVIRONMENTAL ELECTROCHEMISTRY

Course Syllabus – Spring 2017

Class: 3:05 – 4:20 PM Tuesday & Thursday, 109 Sackett Building

Instructor: **Prof. Christopher Gorski**
231-F Sackett Building; gorski@psu.edu; 814-865-5673

Office Hours: Mondays and Wednesdays 4:00 – 4:45 PM

Texts: There is no required textbook. The recommended textbook is:
Electrochemical Methods: Fundamentals and Applications. Bard, A.J. and Faulkner, L.R. John Wiley & Sons Inc. 2nd Edition. ISBN-10: 0471043729.

We will also review journal articles and book chapters over the end of the semester. These will be uploaded as pdfs on Canvas.

Notes: Skeletal lecture notes will be provided online through Canvas >24 hours before class.

Course Description: This course introduces students to the field of electrochemistry and applications of electrochemical techniques and principles to environmental engineering and science. The overall goal of the course is to enable students to critically evaluate environmental electrochemical literature and to design and develop their own experimental systems. The course is divided into five major sections:

1. Electrode Potentials and Redox Chemistry
2. Galvanic and Electrolytic Reactions
3. Electrochemical Kinetics and Transport
4. Electrochemical Techniques
5. Electrochemical Impedance Spectroscopy

The sections will contain a combination of lectures, in-class problem solving, and discussions of scientific literature. In each section, homework assignments will involve a combination of traditional problem solving and (re-)interpreting the data from scientific papers. Because this class is small, I ask that you actively participate in discussions, lectures, and problem-solving periods.

Evaluation:

3 Quizzes (equally weighted)	30 %
5 Homeworks	50 %
Final Exam	20 %
Total	100 %

The standard grading system will be used to assign final letter grades in the course (A = 94 – 100%; A- = 90 – 93%; B+ = 87 – 89%; B = 84 – 86%; B- = 80 – 83%; C+ = 76 – 79%; C = 70 – 75%; D = 60 – 69%; F = 0 – 59%).

Homework: Approximately 5 homework assignments will be given over the semester. Each homework assignment will be worth 20 points. Homework will be due at the start of class. Because feedback is meant to be quick, **late homework will *only* be accepted within 24 hours of the time it is due.** Late homework can be turned into Dr. Gorski's mailbox in 217 Sackett, and 25% will be deducted from the score for tardiness. **You must show your work to receive full credit.** Neatness counts: illegible or messy work will be penalized. Effort also counts: you will receive partial credit for trying problems even if the solution is incorrect.

Quizzes: This course will have approximately three quizzes over the course of the semester. They will either be in-class or take-home. No makeups will be allowed, although with legitimate justification (e.g., job interview, family emergency, etc.), quizzes may be excused.

Final Exam: There will be a cumulative final exam at the end of the course.

Participation: You are expected to attend class and participate. In extreme cases, points will be deducted if you do not participate and/or attend.

Academic Honesty: Students are encouraged to work together on homework assignments; however, original solutions are required. The University defines academic integrity as the pursuit of scholarly activity in an open, honest, and responsible manner. All students should act with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts. Dishonesty of any kind will not be tolerated in this course. Dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students. *Students who are found to be dishonest will receive academic sanctions and will be reported to the University's Office of Student Conduct for possible further disciplinary sanctions.* If you are not familiar with what constitutes as an academic integrity violation, please read Penn State's policies: http://www.engr.psu.edu/FacultyStaff/AcademicIntegrity.aspx.

Disabilities: Penn State welcomes students with disabilities into the University's educational programs. If you have a disability-related need for reasonable academic adjustments in this course, contact the Office for Disability Services (ODS) at 814-863-1807 (V/TTY). For further information regarding ODS, please visit the Office for Disability Services Web site at http://equity.psu.edu/ods/.

To receive consideration for course accommodations, you must contact ODS and provide documentation (see the documentation guidelines at http://equity.psu.edu/ods/guidelines/ documentation-guidelines). If the documentation supports the need for academic adjustments, ODS will provide a letter identifying appropriate academic adjustments. Please share this letter and discuss the adjustments with your instructor as early in the course as possible. You must contact ODS and request academic adjustment letters at the beginning of each semester.

Course Schedule: Each of the five sections will be composed of approximately 2-4 weeks. I will keep a rigorous schedule up on Angel that will project out a few weeks. A detailed version of the course schedule is provided on the following page.

Tentative Course Schedule:

Week	Date	Class	Homework
1	1/10	Course Introduction	
	1/12	1.1 Origin of electrode potentials	
2	1/17	1.2 Equilibrium electrode potentials	
	1/19	1.3 Capacitance and other types of potentials	
3	1/24	1.4 Environmental redox chemistry I	
	1/26	1.5 Environmental redox chemistry II	
4	1/31	1.6 Measuring potentials in environmental systems	HW 1 due
	2/2	**Quiz 1**	
5	2/7	2.1 Voltaic cells	
	2/9	2.2 Reversibility	
6	2/14	***No class***	
	2/16	2.3 Environmental batteries and capacitors	
7	2/21	3.1 Introduction to reaction kinetics	HW 2 due
	2/23	3.2 Transition state theory	
8	2/28	3.3 The Butler-Volmer equation	
	3/2	3.4 Transport	
Spring Break – March 6-10			
9	3/14	4.1 Intro to electrochemical techniques	HW 3 due
	3/16	**Quiz 2**	
10	3/21	4.2 Voltage sweep techniques	
	3/23	4.3 Cyclic voltammograms	
11	3/28	4.4 The rotating disk electrode (RDE)	
	3/30	4.5 Other electrochemical techniques	HW 4 due
12	4/4	**Quiz 3**	
	4/6	5.1 Impedance I	
13	4/11	*Buffer week*	
	4/13	*Buffer week*	
14	4/18	5.2 Impedance II	
	4/20	5.3 Electrochemical Cells and Circuits	
15	4/25	5.4 Interpreting Impedance Spectra	
	4/27	Review/catchup	HW 5 due