MSE 598 Special Topics: Electrochemical Energy Storage and Conversion
(Crosslisted as: MSE 494, CHE 494, CHE 598, NAN 598, MAE 598)

Course Syllabus
Instructor: Prof. Candace Chan
(Tel: 480-727-8614, email: candace.chan@asu.edu)
Office hours: Tuesday 4:30-5:30 pm or by appointment, ISTB4 381

Semester: Fall 2012
Meeting Day, Time and Place: Tues/Thurs, 12-1:15 pm, ECG 215

Course Description
This course will introduce electrochemical concepts relevant to real-world devices such as electrochemical energy storage devices, photoelectrochemical energy conversion devices, and solid-state electrochemical devices such as sensors. Basic electrochemical principles with an emphasis on solid state electrochemistry and the nature of the solid-electrolyte interface will be discussed, in order to give students the background knowledge needed for understanding and analyzing real device performance of, e.g. lithium-ion batteries, solar hydrogen generation, electrocatalysts, electrochemical capacitors, etc. By the end of the course, students will be able to critically evaluate media reports and journal publications describing electrochemical energy conversion and storage devices.

Prerequisites: Undergraduate-level general chemistry (e.g. CHM 114, 116) and intro physics (e.g. PHYS 121-131); intro materials science (e.g. MSE 250) and thermodynamics (e.g. MSE 330) highly recommended. For graduate students and advanced undergraduates in engineering and physical science disciplines.

Textbooks: There is no single textbook available that covers the breadth of subjects that will be discussed in this class. Lecture material will be taken from various books and publications, all of which can be obtained online as ebooks using the ASU library license.


Other sources:
Solid State Electrochemistry, Bruce
Electrochemical Methods, Bard & Faulkner
Semiconductor electrodes and photoelectrochemistry, Licht
The CRC Handbook of Solid State Electrochemistry, Gellings & Bouwmeester

Course Content Changes
Course content may vary from this outline to meet the needs of this particular group. Dates for class tests may also be shifted.

Homework
Development of problem solving, critical thinking and analytical skills is a critical component of this course content. Graded problem sets will be assigned for practice in problem solving techniques and capacity for critically analyzing electrochemical data. Active participation in attempting these problems is essential for success in this course. Unless you work attentively and persistently on these problems
you will not achieve the course objectives. Students who fall substantially behind on these problems are unlikely to perform well on the tests. Students are encouraged to have “study buddies” and may work together on homeworks in groups, but each student must turn in their own work. Homework assignments that are duplicated, plagiarized, or violate ASU’s Academic Integrity Policies (https://provost.asu.edu/academicintegrity) will be reported as per University policy.

**Attendance Policy**
Attendance in this class is important and is strongly encouraged.

**Disability Policy**
The university will make reasonable accommodations for persons with documented disabilities. Students should notify Prof. Chan of any special needs.

**Course Grading**
1. Homework will count for 20% of the final grade. Homeworks are generally assigned on Thurs and due the following Thurs at the beginning of class. Late homework will not be accepted.

2. One midterm test worth 30% of the final grade is tentatively scheduled for **Oct. 9**.

3. A final comprehensive exam worth 30% of the final grade will be held during the final exam period of Dec. 13 – 20. Details of the final will be announced later.

4. A final presentation worth 20% of the final grade will be required for graduate students. This assignment will be a conference-style oral presentation on a journal publication of the student’s choice (provided it is related to the course material). The goal of this assignment is for students to practice their critical thinking and apply course concepts towards understanding real-life examples, while also developing oral presentation skills. Undergraduate students will write a final paper instead of a final presentation. Details of these assignments will be announced later.

Grading basis:
- Homework 20%
- Midterm 30%
- Final exam 30%
- Final presentation 20%

Plus/minus grading will be used.

Regrades of homeworks and exams will only be conducted if the student turns in a written explanation of why they think an error was made in the grading, along with the original work, to Prof. Chan within one week of the time the graded work was returned to the student.

**Extra Credit**
There are no separate extra credit assignments for this class. The schedule of assignments and exams are sufficient to test your understanding of the materials presented in the course. However, occasionally there will be opportunities for extra credit in the homework problems.
**Blackboard**
I will use Blackboard to post lecture notes, homework and other resources that may help you. To access Blackboard use the following:

1. Go to Blackboard: [http://myasucourses.asu.edu](http://myasucourses.asu.edu)
2. Under My Courses, select MSE 598 Topic: Electrochemical Energy Storage
3. On lefthand panel, select Course Information
4. For lecture notes go to Lectures folder, for homework go to Homework folder etc...

**Course Plan (subject to change)**

Week 1: Introduction
- Intro to basic electrochemical principles
- The electric double layer and electrochemical capacitors

Week 2
- Thermodynamics related to voltages and redox chemistry

Week 3: The solid-electrolyte interface
- Interfacial electrochemistry
- Intro to electrocatalysts and electrochemical reactors

Week 4: Semiconductor electrochemistry
- Semiconductor/electrolyte interface
- Basics of photoelectrochemical cells and photocatalysis

Week 5-6: Solid state electrochemistry
- Defect chemistry
- Solid state ionics
- Solid and polymer ionic conductors
- Fuel cells

Week 7-8
- Electrochemistry of mixed ionic-electronic conductors
- Solid state redox reactions

Week 9-10
- Batteries

Week 11-12
- Other topics

Week 13-15: Student presentations

**Important dates:**

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<thead>
<tr>
<th>Date</th>
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<tbody>
<tr>
<td>10/16</td>
<td>Fall break, no class</td>
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<tr>
<td>11/22</td>
<td>Thanksgiving, no class</td>
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<td>12/11</td>
<td>Last day of class</td>
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<td>12/13-12/20</td>
<td>Finals</td>
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