Syllabus

ECH 6709: Electrochemical Engineering: Fundamentals and Design     3 credits

Section 3291           Fall 2013

Instructor: Mark E. Orazem
Office: 327 Chemical Engineering Building
Phone: 392-6207
Office Hours: TBD
E-mail meo@che.ufl.edu
Website http://www.che.ufl.edu/orazem/

Class Hours Location
Tuesday, Period 2,3 (8:30 – 10:25 AM) LAR 310
Thursday, Periods 2,3 (8:30 – 10:25 AM) LAR 310
Final Exam, 13A, Friday, December 13, 2013 (7:30-9:30 AM) LAR 310

1. Catalog Description: Fundamentals of electrodics and ionics applied to systems of interest in electrochemical engineering.

2. Prerequisites and Co-requisites: Graduate-level understanding of transport phenomena, thermodynamics, and reaction kinetics – or permission of instructor.

3. Electrochemical phenomena and processes are covered from an engineering perspective. This course introduces electrochemical engineering as an extension to the fields of transport phenomena, thermodynamics, reaction and design that encompass Chemical Engineering.

3. Course Objectives:
   Electrochemical phenomena and processes are covered from an engineering perspective. This course introduces electrochemical engineering as an extension to the fields of transport phenomena, thermodynamics, reaction and design that encompass Chemical Engineering. The course has the following organization:
   A. Fundamentals: Thermodynamics, electrode kinetics, interfacial phenomena, and transport processes as applied to electrochemical systems. This section will encompass as well the influence of coupled kinetic, interfacial, and transport phenomena on current and potential distributions in a variety of electrochemical systems.
   B. Applications of Electrochemical Principles: The emphasis will be on applying a fundamental understanding to electrochemical topics of current interest. The list of subjects will include: fundamentals of electrochemical measurements and applications of electrokinetic phenomena.

4. Contribution of Course to Meeting the Professional Component: Does not apply.

5. Relationship of Course to Program Outcomes: Does not apply.

6. Instructor: See above.

7. Teaching Assistant: None.

8. Meeting Times: See above.

9. Class/Laboratory Schedule: See above.

10. Meeting Location: See above.

11. Materials and Supplies Fees: None.

Note: Exams will be open-book, and use of computers and phones will be prohibited. Thus, a paper copy of the book will be required.

13. **Recommended Reading:**

14. **Course Outline:** The subjects to be covered will follow the content of the course textbook.

**Fundamentals**
- Chapter 11  Infinitely Dilute Solutions
- Chapter 2  Thermodynamics in Terms of Electrochemical Potentials
- Chapter 3  The Electric Potential
- Chapter 4  Activity Coefficients
- Chapter 5  Reference Electrodes
- Chapter 6  Potentials of Cells with Junctions
- Chapter 7  Structure of the Electric Double Layer
- Chapter 8  Electrode Kinetics
- Chapter 1  Introduction

**Current and Potential Distributions**
- Chapter 15  Fluid Mechanics
- Chapter 17  Convective-Transport Problems
- Chapter 18  Applications of Potential Theory
- Chapter 19  Effect of Migration on Limiting Currents
- Chapter 21  Currents below the Limiting Current

**Special Topics**
- Chapter 9  Electrokinetic Phenomena
- Chapter 10  Electrocapillary Phenomena

**Optional Topics**
- Chapter 20  Concentration Overpotential
- Chapter 12  Concentrated Solutions
- Chapter 22  Porous Electrodes
- Chapter 23  Semiconductor Electrodes
- Instructor Measurement Techniques

The tentative schedule for exams and materials covered is attached.

15. **Attendance and Expectations:** Attendance is required; penalties for absence and tardiness may be assigned at the discretion of the instructor. Cell phones may not be used in class.

16. **Grading:** The grading schedule used will depend on the size of the class. If the class is large, the grades will be based solely on exams. If the class size is moderate, homework may also be included in the calculation of the final grade. The tentative grading is:

<table>
<thead>
<tr>
<th>Mid-term exams (2)</th>
<th>60%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final exam</td>
<td>40%</td>
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</tbody>
</table>
17. **Grading Scale:** Grades for this class are curved at the discretion of the instructor. Attendance and class participation will be considered. Please note: By University of Florida policy, “Graduate students need an overall GPA of 3.00 truncated and a 3.00 truncated GPA in their major (and in the minor, if a minor is declared) at graduation.” For more information on grades and grading policies, please visit: http://gradcatalog.ufl.edu/content.php?catoid=4&navoid=907#grades.

18. Requirements for class attendance and make-up exams, assignments, and other work are consistent with university policies that can be found at: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx

19. **Honesty Policy:** All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your obligation as a UF student and to be honest in all work submitted and exams taken in this course and all others.

   Note that failure to comply with this commitment will result in disciplinary action compliant with the UF Student Honor Code Procedures. See http://www.dso.ufl.edu/sccr/procedures/honorcode.php.

20. **Accommodation for Students with Disabilities:** Students requesting classroom accommodation must first register with the Dean of Students Office. That office will provide the student with documentation that he/she must provide to the course instructor when requesting accommodation.

21. **UF Counseling Services:** Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:
   - UF Counseling & Wellness Center, 3190 Radio Rd, 392-1575, psychological and psychiatric services.
   - Career Resource Center, Reitz Union, 392-1601, career and job search services.

22. **Software Use:** All faculty, staff and student of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

23. **Relevant Aspects of the Chemical Engineering Policy on Exams**
   a) All exams will include the honor pledge and students must sign their name by the pledge.
   b) All students must leave backpacks, bags, etc., in the front of the classroom as they enter.
   c) Students are asked not to bring cell phones in the exam. In case they do, they have to place the cell phones in the front of the classroom. The department and proctors have no responsibility in case of theft (cell phones should not be brought). A cell phone discovered on a student's person may result in a zero grade for the exam. If a student is expecting an important call, he or she must discuss this with the proctors before starting the exam.
   d) Students are required to remove their hats during the exam and place them in the front of the classroom.
   e) In open book exams no printed material other than the textbook is allowed. A solution manual or printouts from solution manuals will result in a zero grade for the exam and additional harsher penalties.
   f) Any talking between students is strictly prohibited and will result in a zero grade for the exam.
   g) Students may not leave the room before turning in the exam.
<table>
<thead>
<tr>
<th>Date</th>
<th>Topics Covered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug. 29, 2013</td>
<td>Chapter 2. Thermodynamics in Terms of Electrochemical Potentials</td>
</tr>
<tr>
<td>Sep. 3, 2013</td>
<td>International Workshop on Green Energy Conversion, Kofu, Japan</td>
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<tr>
<td>Sep. 5, 2013</td>
<td>ISE Annual Meeting, Santiago de Querétaro, Mexico</td>
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<tr>
<td>Sep. 10, 2013</td>
<td>Chapter 2. Thermodynamics in Terms of Electrochemical Potentials (continued)</td>
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<tr>
<td>Sep. 17, 2013</td>
<td>Chapter 2. Thermodynamics in Terms of Electrochemical Potentials (continued)</td>
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<tr>
<td>Sep. 24, 2013</td>
<td>Exam 1</td>
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<tr>
<td>Oct. 8, 2013</td>
<td>Chapter 7. Structure of the Electric Double Layer</td>
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<tr>
<td>Oct. 12, 2013</td>
<td>MRS Fall Meeting, Boston MA</td>
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<td>Oct. 15, 2013</td>
<td>Chapter 1. Introduction</td>
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<td>Oct. 17, 2013</td>
<td>ECS Fall Meeting, San Francisco</td>
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<tr>
<td>Oct. 22, 2013</td>
<td>Review</td>
</tr>
<tr>
<td>Oct. 24, 2013</td>
<td>Exam 2</td>
</tr>
<tr>
<td>Nov. 5, 2013</td>
<td>Chapter 17. Convective-Transport Problems</td>
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<td>Nov. 7, 2013</td>
<td>Chapter 18. Applications of Potential Theory</td>
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<td>Nov. 12, 2013</td>
<td>Chapter 19. Effect of Migration on Limiting Currents</td>
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<td>Nov. 14, 2013</td>
<td>Chapter 21. Currents below the Limiting Current</td>
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<tr>
<td>Nov. 21, 2013</td>
<td>MRS Fall Meeting, Boston MA</td>
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<tr>
<td>Nov. 26, 2013</td>
<td>Chapter 10. Electrocapillary Phenomena</td>
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<tr>
<td>Nov. 28, 2013</td>
<td>Thanksgiving (class not held)</td>
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<tr>
<td>Dec. 3, 2013</td>
<td>MRS Fall Meeting, Boston MA</td>
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<tr>
<td>Dec. 13, 2013</td>
<td>Final Exam (7:30-9:30 AM)</td>
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