Chemistry 837  
Spring 2020  
Electroanalytical Chemistry

Course Organization, Lecture Syllabus and Other Important Information

Lectures:  
Monday, Wednesday 9:10 – 10:00 am  
Third Weekly Lecture - To Be Determined

Location:  
1202 Engineering Building

Course Website:  
D2L

Textbooks:  


Instructor:  
Professor Greg M. Swain  
314 Chemistry Building  
Tel. 353-1090  
Email: swain@chemistry.msu.edu

Instructor Office Hours:  
By appointment. (usually an open-door policy)

Course Description
This in-depth course covers the fundamental principles of electrochemistry and electrochemical methods of analysis. The course will cover topics in physical as well as electroanalytical chemistry. The student will learn about the theoretical and practical aspects of electrochemical measurements, whether they be used for determining some physical property a system or for detecting an analyte. Using a combination of problem-based learning approaches, case studies and traditional lectures, the student will develop critical thinking skills in the areas of electrochemical method selection, method development and data interpretation.

Course Objectives
1. Understand the basics of electrode processes and how thermodynamics, electron-transfer kinetics and mass transport control electrochemical reactions.
2. Understand how to design electrochemical experiments to solve problems in chemical analysis.
3. Learn about ways in which electrochemical methods are used to solve problems in health and the environment, and how to evaluate the resulting data.
4. Improvement of written communication skills through the preparation of a literature-based research paper on an assigned case study.

5. Improvement of oral communication skills through delivery of an oral presentation on an assigned case study.

**Exam Schedule**

February 7th (Exam 1 – in class)
March 13th (Exam 2 – in class)
April 17th (Exam 3 – in class)

**Grading**

There is a total of 800 points available for this course:

- Ten weekly quizzes (10 pts ea.) (100 points total)
- Three 1-h exams worth 100 points each (300 points total)
- Term Paper/Case Study (100 points total)
- Oral presentation/Case Study (100 points total)
- Final Exam (200 points total)

**Grading Scale**

The scale indicated below is based on the number of total points accrued being converted to a percentage of the total points available. These grade cut-offs are based on historical experience with this course and they may be relaxed by a small amount, at the instructor’s discretion, based on the class exam results. In no event shall the grade levels be made more stringent than indicated below.

<table>
<thead>
<tr>
<th>Raw score (800 max)</th>
<th>Percentile score</th>
<th>Course grade</th>
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</thead>
<tbody>
<tr>
<td>720 – 800</td>
<td>90.0 – 100%</td>
<td>4.0</td>
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<tr>
<td>680 – 729</td>
<td>85.0 – 89.9%</td>
<td>3.5</td>
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<tr>
<td>640 – 679</td>
<td>80.0 – 84.9%</td>
<td>3.0</td>
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<tr>
<td>600 – 639</td>
<td>75.0 – 79.9%</td>
<td>2.5</td>
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<tr>
<td>560 – 599</td>
<td>70.0 – 74.9%</td>
<td>2.0</td>
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**Homework**

Problems will be assigned but **not** collected for any credit or grade. Answer keys will be posted on the D2L course website.

**Lecture Schedule**

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture Topic</th>
<th>Chapter (Bard and Faulkner)</th>
<th>Problems</th>
<th>Case Study (Friday class)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan. 6, 8 &amp; 10</td>
<td>Overview of Electrode Processes and Double Layer Structure</td>
<td>1</td>
<td>1,3,5,6</td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>Topic</td>
<td>Section</td>
<td>References</td>
<td>Group</td>
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<tr>
<td>Jan. 13, 15 &amp; 17</td>
<td>Thermodynamics of Cells and Electrode Reactions</td>
<td>2</td>
<td>2,4,6</td>
<td>Group 1</td>
</tr>
<tr>
<td>Jan. 20</td>
<td><strong>NO CLASS  MLK Holiday</strong></td>
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<td></td>
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<tr>
<td>Jan. 22 &amp; 24</td>
<td>Kinetics of Electrode Reactions I</td>
<td>3</td>
<td>1,5,9</td>
<td>Group 2</td>
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<tr>
<td>Jan. 27, 29 &amp; 31</td>
<td>Kinetics of Electrode Reactions II</td>
<td></td>
<td></td>
<td>Group 3</td>
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<tr>
<td>Feb. 3, 5 &amp; 7</td>
<td>Mass Transport</td>
<td>4</td>
<td>2,3</td>
<td>Exam I (2/7)</td>
</tr>
<tr>
<td>Feb. 10, 12 &amp; 14</td>
<td>Potential Step Methods</td>
<td>5</td>
<td>2,4,5</td>
<td>Group 4</td>
</tr>
<tr>
<td>Feb. 17, 19 &amp; 21</td>
<td>Potential Sweep Methods</td>
<td>6</td>
<td>4,5,9</td>
<td>Group 5</td>
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<tr>
<td>Feb. 24, 26 &amp; 28</td>
<td>Corrosion Basics I</td>
<td></td>
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<td>Group 6</td>
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<td>Mar. 2-6</td>
<td><strong>SPRING BREAK</strong></td>
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<td>Mar. 9, 11 &amp; 13</td>
<td>Rotating Disk Voltammetry</td>
<td>9</td>
<td>3,4,5</td>
<td>Exam 11 (3/13)</td>
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<tr>
<td>Mar. 16, 18 &amp; 20</td>
<td>Electroactive Layers and Modified Electrodes</td>
<td>14</td>
<td>1,3,4</td>
<td>Group 7</td>
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<tr>
<td>Mar. 23, 25 &amp; 27</td>
<td>Amperometric Sensors and Biosensors</td>
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<td>Group 8</td>
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<tr>
<td>Mar. 30 and Apr. 1 &amp; 3</td>
<td>Potentiometry</td>
<td>2</td>
<td>14,16,19</td>
<td>Group 9</td>
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<tr>
<td>Apr. 6, 8 &amp; 10</td>
<td>Neuroelectrochemistry</td>
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<td></td>
<td>Group 10</td>
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<tr>
<td>Apr. 13, 15 &amp; 17</td>
<td>Anodic Stripping Voltammetry</td>
<td>11</td>
<td>15, 16, 17</td>
<td>Exam III (4/17)</td>
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<tr>
<td>Apr. 20 &amp; 22</td>
<td>Spectroelectrochemistry</td>
<td>17</td>
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<td>Apr. 24</td>
<td>Review for Final Exam</td>
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<td>April 28 (Tuesday)</td>
<td>Final Exam (12:45-2:45 pm)</td>
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**Research Paper**
You will write a 10-page literature-based research paper (Times Roman, 11-point, 1.5 line spacing) on the case study you were assigned. The paper should utilize a minimum of five references (Web of Science, Scifinder Scholar and or PubMed). The term paper should have the following sections: **Background and Motivations** (reasons for the work, benefits of the science and overview of the electrochemical method or sensor used), **Experimental Approach** (details of the method, electrode preparation and or sensor design), **Example Data and Interpretation**, and **Conclusions and Future Perspectives**. All figures are to be scanned and embedded into the text. All text used in your paper and written by another author should be appropriately cited. All papers are due on or before April 3rd.

**Oral Presentation (Case Study)**
As part of a team (2 or 3 students), you will prepare and present a lecture/class discussion on the case study you were assigned. The case study will focus on one paper, but you will have to search the literature for associated and background articles needed to understand the work presented in the main paper. Go to MSU Libraries and search the scientific literature databases (Scopus, Scifinder, Web of Science and or Pubmed)
In this Case Study, you will discuss the purpose for the work, the design of the instrumental method used and its operational principles, the data presented, and the conclusions reached. See the syllabus for your presentation date. The course instructor will review your presentation materials, at your request, prior to the scheduled presentation date.

**Religious Observances/ Other Absences from Class**
It is the responsibility of students who plan to be absent from class at certain times throughout the semester, due to religious holidays or other reasons, to make arrangements *in advance* with the instructor. Course notes or handouts may be obtained from the instructor if these conditions are met. If a make-up exam is required, the instructor retains the right to determine the content of the exam and the conditions of administration, giving due consideration to equitable treatment.

**Academic Honesty**
Academic dishonesty at Michigan State University is defined by the *General Student Regulations* as conduct that violates the fundamental principles of truth, honesty, and integrity. The following conduct is specifically cited:

- Supplying or using work or answers that are not one's own.
- Providing or accepting assistance with completing assignments or examinations.
- Interfering through any means with another's academic work.
- Faking data or results.

You are expected to complete all course assignments, including homework, quizzes, tests and exams, without assistance from any source. You may work together with your classmates on course material but submit your own work. You are expected to develop original work for this course; therefore, you may not submit course work you completed for another course to satisfy the requirements for this course. Also, you are not authorized to use the [www.allmsu.com](http://www.allmsu.com) or similar websites to complete any course work in this course.

Students who violate these rules WILL be assigned a failing grade for the course.

**Social Media Policy**
As members of a learning community, students are expected to respect the intellectual property of course instructors. All course materials presented to students are the copyrighted property of the course instructor and are subject to the following conditions of use:

1. Students may not record lectures or any other classroom activities and use the recordings only for their own course-related purposes without permission from the instructor.

2. If granted permission, students may share the recordings with other students enrolled in the class. Sharing is limited to using the recordings only for their own course-related purposes.

3. Students may not post the recordings or other course materials online or distribute them to anyone not enrolled in the class without the advance written permission of the course instructor and, if applicable, any students whose voice or image is included in the recordings.
4. Any student violating the conditions described above may face academic disciplinary sanctions.

**Special Requests**
[https://www.rcpd.msu.edu/](https://www.rcpd.msu.edu/)

Michigan State University is committed to providing equal opportunity for participation in all programs, services and activities. Requests for accommodations by persons with disabilities may be made by contacting the Resource Center for Persons with Disabilities at 517-884-RCPD or on the web at the link shown above. Once your eligibility for an accommodation has been determined, you will be issued a verified individual services accommodation (“VISA”) form. Please present this form to me at the start of the term and/or two weeks prior to the accommodation date (first test date). Requests received after this date will be honored whenever possible.

**Diversity, Equality and Inclusivity**
[https://diversity.chemistry.msu.edu/resources/](https://diversity.chemistry.msu.edu/resources/)

Throughout this course, we will work together to create an inclusive learning environment in which individuals are included, valued and respected. Members of the faculty, teaching staff and student population come from a variety of educational and cultural backgrounds and hold diverse beliefs. Our department encourages the exploration of and engagement in both divergent scientific approaches and diverse learning methods. All students and their views and contributions will be respected by all.