Draft: CH694 Applied Electrochemistry Projects Laboratory Winter 2021

I. Course Identity, Teaching Staff, and Logistics

**Instructor:** New hire or Prof. Shannon Boettcher, email: swb@uoregon.edu, office: 435 LISB, Phone: 541-346-2543

**Office hour:** There will be two office hours per week. The times will be determined on the first day of lecture based on student availability.

**Format:** Laboratory and team-based learning.

**Credits:** 4

**Location:** Required laboratory hours, Tuesday/Thursday 2:00 pm - 4:50 pm will meet in the Oregon Center for Electrochemistry (Onyx 372, tentatively)

**Required course materials:**

**Electrochemistry Projects Laboratory Manual:** Each student will be provided a laboratory manual that includes key articles from the scientific literature related to the team’s research project. Typically these will include both review/tutorial articles (20-50 journal pages in length) and 5-10 key original research articles. Relevant book chapters may be assigned for reading as well.


**Additional course materials:**


**Course website:** Laboratory Project Assignments, lecture notes, videos, and grades will be posted on the Canvas course site.

**Prerequisites:** Advanced Electrochemistry CH454/554.

**Co-requisite:** Electrochemical Device Engineering CH692
II. Course Description

In CH692 students learn the theory of how electrochemical devices function. In CH693, students build and test electrochemical devices to better understand how they function and the factors that determine performance. In this course, CH694, students work in teams (3-4 students per team) to solve open-ended research and development projects in electrochemistry. The applied research and development projects for the course come from industry partners and academic research laboratories. This allows the students to develop skills solving unstructured problems representative of what they will face in their career. One example includes building alkaline membrane electrolyzers and understanding the design parameters that drive energy efficiency and durability that are currently unknown in the field. The course will be taught by the electrochemical technology program director in collaboration with UO faculty. PhD student course teaching assistants (GEs) with expertise in the project content will mentor and work with the teams of electrochemistry MS students. The output will be a formal report to the industry sponsor or academic peer-reviewed publication where the students are coauthors. Laboratory space in the Oregon Center for Electrochemistry will be used for instruction. The students will also use the Center for Advanced Materials Characterization in Oregon (CAMCOR) to augment electrochemical analyses. The class will meet two afternoons a week (3 h each) for mandatory laboratory/group-discussion sessions led by the instructor and/or teaching assistant. During this time the teams will present their weekly progress update, be able to ask questions of the instructor(s), and receive training for any equipment as needed. Open laboratory times will also be established for students to work at their own pace and on their own schedule on the assigned projects, after appropriate safety training and with oversight as needed. Feedback from industry partners will drive laboratory project content evolution.

III. Expected Learning Outcomes

- Develop project planning and management skills needed to complete longer scale applied research and development projects
- Develop presentation and speaking skills necessary to give routine technical project updates
- Learn to apply foundational concepts in chemical thermodynamics, kinetics, and mass transport to optimize the operation and performance of practical electrochemical devices
- Develop deep understanding of specific electrochemical device being researched
- Learn to find and assess the primary literature to drive decision making

IV. Estimated Student Workload

Course participants will attend laboratory sessions, perform assigned reading, attend open laboratory times and collect data, analyze data, present their data, and write a final professional report or manuscript for submission to a peer reviewed journal. The table below shows the estimated workload.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Estimated hours per term</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation for weekly project</td>
<td>20</td>
<td>10 project updates, 2 h per</td>
</tr>
<tr>
<td>Activity</td>
<td>Estimated hours per term</td>
<td>Comments</td>
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<tr>
<td>-------------------------------</td>
<td>--------------------------</td>
<td>--------------------------------------------------------------------------</td>
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<tr>
<td>updates</td>
<td></td>
<td>update</td>
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<tr>
<td>Open Laboratory Time</td>
<td>70</td>
<td>Estimated at 7 h / week</td>
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<tr>
<td>Mandatory Laboratory Sessions</td>
<td>60</td>
<td>6 h / week</td>
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<td></td>
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<td>High quality report or paper suitable for submission to peer-reviewed journal. Each team (~3 students) will work in collaboration to draft paper.</td>
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<tr>
<td>Final report/paper</td>
<td>10</td>
<td></td>
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<tr>
<td>Total hours:</td>
<td>160</td>
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</tbody>
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V. How Grades Will Be Determined

The grades will be determined based on the following percentage breakdown of the final total score:

*Professionalism and safety in the laboratory setting - 10%*
*Quality of laboratory notebook data collection and analysis – 30%*
*Quality of weekly research updates – 30%*
*Final project report/paper – 30%*

Professionalism and safety in the laboratory setting will be assessed by the teaching assistant throughout the course. Students engaging in unsafe laboratory practices will lose credit and be given a warning. A second infraction will result in the student being removed from the course. Students are also expected to interact with each other in a professional manner with effort focused and meeting the project deliverables. Unprofessional conduct will result in loss of credit.

The quality of each student’s laboratory notebook (digital and physical) will be assessed through periodic unannounced notebook checks. During a check each student must be able to find and explain key data collected, including providing details of how the data was collected and the sample/device history. The goal of the notebook checks is to teach appropriate attention to detail when recording experimental data and observations.

Each student will also give a weekly update on research progress (10 min with questions). Each presentation should be concise and clear. Each presenter will answer questions pertaining to the presentation. Feedback will be given after each presentation so the presenter can systematically improve their presentation skills during the course of the 10-week class. Grades will be based on the clarity of the presented data and quality of the information delivery.

The final project/paper will be graded based on the quality of the document. Reports/papers are expected to be concise formal documents (if a manuscript it must be formatted to meet
ACS or other publication standard) with professional quality graphs (including appropriate use of units and error estimates) and data analysis, formatted references, and insightful discussion of the data. Students will receive a separate document detailing expectations.

A = Clearly written, concise document, with high-quality figures. All required pieces of data are shown and discussed without major errors in the interpretation. Appropriate use of references.

B = One or more issues with the items above.

C = Multiple issues with quality of the written document and interpretation/discussion.

D = Multiple issues and incomplete.

+/- grades will be applied consistent with the above criteria. A+ will be given for near-perfect reports with high quality data.

A+ course grades will be given to the top-performing students in the course, provided they reach >95%. Students earning >90% in the course will earn at least and A, > 80% at least a B, >70% at least a C, and >60% at least a D. The instructor may curve the course to increase the letter grades for a given percentage score to account for variations in difficulty of the exam questions from year-to-year. Students with a given percentage score will not, however, earn a grade lower than that indicated above.

VI. Course Schedule and Assignments

Assigned reading: Weekly reading from Fuller and Harb given after each topic. Reading should be started prior to the start of the weekly lectures and completed before the start of the following weeks lectures. Problem Sets are due on the 2nd lecture of the week following their assignment.

Week 1
Laboratory Meeting 1: Laboratory Safety Review. Training as needed for instrumentation. Project Discussion.
Laboratory Meeting 2: Training as needed for instrumentation. Project Discussion.
Reading: Primary literature associated with team’s specific research project.

Week 2
Laboratory Meeting 1: Weekly project updates from each team. Training as needed for instrumentation. Project Discussion.
Laboratory Meeting 2: Weekly project updates from each team. Training as needed for instrumentation. Project Discussion.
Reading: Primary literature associated with team’s specific research project.

Week 3
**Laboratory Meeting 1:** Weekly project updates from each team. Training as needed for instrumentation. Project Discussion.

**Laboratory Meeting 2:** Weekly project updates from each team. Training as needed for instrumentation. Project Discussion.

**Reading:** Primary literature associated with team’s specific research project.

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**Week 4**

**Laboratory Meeting 1:** Weekly project updates from each team. Training as needed for instrumentation. Project Discussion.

**Laboratory Meeting 2:** Weekly project updates from each team. Training as needed for instrumentation. Project Discussion.

**Reading:** Primary literature associated with team’s specific research project.

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**Week 5**

**Laboratory Meeting 1:** Weekly project updates from each team. Training as needed for instrumentation. Project Discussion.

**Laboratory Meeting 2:** Weekly project updates from each team. Training as needed for instrumentation. Project Discussion.

**Reading:** Primary literature associated with team’s specific research project.

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**Week 6**

**Laboratory Meeting 1:** Weekly project updates from each team. Training as needed for instrumentation. Project Discussion.

**Laboratory Meeting 2:** Weekly project updates from each team. Training as needed for instrumentation. Project Discussion.

**Reading:** Primary literature associated with team’s specific research project.

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**Week 7**

**Laboratory Meeting 1:** Weekly project updates from each team. Training as needed for instrumentation. Project Discussion.

**Laboratory Meeting 2:** Weekly project updates from each team. Training as needed for instrumentation. Project Discussion.

**Reading:** Primary literature associated with team’s specific research project.

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**Week 8**

**Laboratory Meeting 1:** Weekly project updates from each team. Training as needed for instrumentation. Project Discussion.

**Laboratory Meeting 2:** Weekly project updates from each team. Training as needed for instrumentation. Project Discussion.

**Reading:** Primary literature associated with team’s specific research project.

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**Week 9**

**Laboratory Meeting 1:** Weekly project updates from each team. Training as needed for
instrumentation. Project Discussion.

**Laboratory Meeting 2:** Weekly project updates from each team. Training as needed for instrumentation. Project Discussion.

**Reading:** Primary literature associated with team’s specific research project.

**Week 10**

**Laboratory Meeting 1:** Weekly project updates from each team. Training as needed for instrumentation. Project Discussion.

**Laboratory Meeting 2:** Weekly project updates from each team. Training as needed for instrumentation. Project Discussion.

**Reading:** Primary literature associated with team’s specific research project.

**Finals Week**

**Wednesday:** Final project/paper due.

**VII. Course Policies**

- Late or missed work will not generally be accepted without prior approval.
- Project reports must be your own work. You may share data across the class if it strengthens the quality of the report but the analysis and discussion of the data in the report must be your own work.
- There will be a zero-tolerance policy for plagiarism in laboratory reports.
- Academic Misconduct: The University Student Conduct Code (available at conduct.uoregon.edu) defines academic misconduct. Students are prohibited from committing or attempting to commit any act that constitutes academic misconduct. By way of example, students should not give or receive (or attempt to give or receive) unauthorized help on assignments or examinations without express permission from the instructor. Students should properly acknowledge and document all sources of information (e.g. quotations, paraphrases, ideas) and use only the sources and resources authorized by the instructor. If there is any question about whether an act constitutes academic misconduct, it is the students’ obligation to clarify the question with the instructor before committing or attempting to commit the act. Additional information about a common form of academic misconduct, plagiarism, is available at https://researchguides.uoregon.edu/citing-plagiarism.
- Accessibility: The University of Oregon is working to create inclusive learning environments. Please notify me if there are aspects of this course that result in disability related barriers to your participation. For more information or assistance, you are also encouraged to contact the Accessible Education Center, Suite 360 Oregon Hall, 346-1155 or uoace@uoregon.edu; website: http://aec.uoregon.edu/content/about
- A graduate employee (GE) will serve as a teaching assistant for this course. The GE’s responsibilities will include assisting in the implementation of the project component of the course, including supervising students completing the projects and
obtaining/distributing materials needed for the project. The GE may assist with grading, and will also be available for general assistance in preparing project reports, completing homework assignments, and preparing for exams. Should graduate students enrolled in the course perceive the course as leading to any conflict of interest, privacy concerns, or unfairness related to having a GE in the above role please contact the instructor to discuss paths of recourse. If the GE is involved in grading assignments, graduate students may request that a faculty member, not the GE, grade their assignments. To do this please make the request in writing via email to the instructor.