

Electrochemical Engineering: Fundamentals and Design

ECH6709 Section 29073

ECH4905 Section 30143

Class Periods: M,W,F | Period 5 (11:45 AM – 12:35 PM)

Location: BLK 0315

Academic Term: Fall 2023

Instructor

Prof. Won Tae Choi

wontae.choi@ufl.edu

352-392-9102

Office Hour: Monday (1:00 – 2:00 PM) or by appointment

Office: ChE425

Teaching Assistant/Peer Mentor/Supervised Teaching Student:

None

Course Description

(3 credits) 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, transport processes, and interfacial phenomena as applied to electrochemical systems. This section will encompass 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 interest. The students will help decide which topics will be presented. The list of subjects may include fundamentals of electrochemical measurements, applications of electrokinetic phenomena, porous electrodes, semiconductor electrodes, batteries, fuel cells, electrocatalysis, and corrosion.

Course Pre-Requisites / Co-Requisites

Graduate-level understanding of transport phenomena, thermodynamics, and reaction kinetics – or permission of instructor.

Course Objectives

This course will introduce students the basic electrochemistry concepts, physical/chemical principles, and engineering practices of electrochemistry and its applications in various electrochemical systems for energy, chemical, biomedical, and electronics industries.

Materials and Supply Fees

Homework assignments, announcements, and grades will be posted on Canvas. Please check Canvas page regularly.

Required Textbooks and Software

- Thomas F. Fuller and John N. Harb, *Electrochemical Engineering*, Wiley, 2018.

Recommended Materials

- J. Newman and N. P. Balsara, *Electrochemical Systems*, 4th edition, Wiley, 2021.
- M. E. Orazem and B. Tribollet, *Electrochemical Impedance Spectroscopy*, 2nd edition, Wiley 2017.
- A. J. Bard and L. R. Faulkner, *Electrochemical Methods: Fundamentals and Applications*, 2nd edition, Wiley, 2000.
- J. O'M. Bockris, A. K. N. Reddy, and M. Gamboa-Aldeco, *Modern Electrochemistry 2A: Fundamentals of Electrodics*, 2nd edition, Springer, 2008.

- G. A. Prentice, *Electrochemical Engineering Principles*, Prentice Hall, 1990.
- D. Pletcher and F.C. Walsh, *Industrial Electrochemistry*, 2nd Edition, Springer, 1990.

Course Schedule (subject to change)

Week 1:	Course overview, basic principles, thermodynamics
Week 2:	Thermodynamics
Week 3:	Kinetics
Week 4:	Kinetics
Week 5:	Transport
Week 6:	Transport
Week 7:	Current distribution
Week 8:	Current distribution
Week 9:	Electrode structures
Week 10:	Electrode structures
Week 11:	Electroanalytical methods
Week 12:	Electroanalytical methods
Week 13:	Special topics
Week 14:	Special topics
Week 15:	Special topics

Special topics will be selected from the list below:

- Batteries
- Fuel cells
- Semiconductor electrodes
- Corrosion
- Electrocatalysis
- Electrochemical measurements

Attendance Policy, Class Expectations, and Make-Up Policy

Attendance of all lectures is highly recommended. Students who do not attend an exam at the scheduled time will receive a score of zero for that exam. **Requests for make-up exams will be considered only for those students who missed due to an acceptable reason.** It is required that, **whenever possible, the student notifies the instructor about the situation prior to the exam, preferably at least two weeks in advance.** Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies. Click here to read the university attendance policies:

<https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>

Evaluation of Grades

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 and in-class problems may also be included in the calculation of the final grade. The tentative grading is:

Assignment	Total Points	Percentage of Final Grade
Homework	75	18.75%
In class problems	75	18.75%
Exam 1 (Midterm)	100	25%
Final Exam	150	37.5%
Total	400	100%

Homework assignments

Homework assignments will be given no more than once per week, generally due the following week. Late homework will not be accepted. Your homework submission must include the pages of the assignment, with all requested answers reported in the answer box below the problem statement. Your homework solutions must include a full description of your problem-solving logic and should be easy to follow in order to receive full credit. You are

permitted to discuss the problems and problem-solving strategies with your colleagues, but you may not breach the Academic Honesty Course Policy (see below). All homework submissions are to be scanned and submitted via CANVAS. There are several free smartphone apps that can scan your work and convert it to a PDF (such as “CamScanner”). Photographs (learn the difference between a PDF and a photograph) are not acceptable.

In-class problem solving sessions

No more than six in-class problem solving sessions will be given during class. Each group (no more than 4 per group) will be required to turn in one solution. You may accumulate up to 75 points combined for the group problems. These sessions will be unannounced and no make-ups will be given.

Exams: Exam 1 (Midterm) and Final

50 min-time-limited Exam 1 (Midterm) and 2 hours Final (12/12/2023, 3:00 PM – 5:00 PM, location: BLK0315) will be assigned. **Format and Date/Time for the Exam 1 will be announced at least 2 weeks in advance.** The final exam is cumulative. During the exams, you are permitted to use a calculator (any model, if it has no communication ability; you also may not share calculators).

Grading Policy

The grades for this class will be curved at the discretion of the instructor.

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.a.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.a.ufl.edu/public-results/>.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by

a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Jennifer Nappo, Director of Human Resources, 352-392-0904, jpennacc@ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students 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.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: <https://counseling.ufl.edu>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the [Office of Title IX Compliance](#), located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://lss.at.ufl.edu/help.shtml>.

Career Connections Center, Reitz Union, 392-1601. Career assistance and counseling; <https://career.ufl.edu>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.
<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>; <https://care.dso.ufl.edu>.

On-Line Students Complaints: <https://distance.ufl.edu/state-authorization-status/#student-complaint>.