

LOYOLA UNIVERSITY CHICAGO  
DEPARTMENT OF CHEMISTRY AND BIOCHEMISTRY

## CHEM 395/455 – How Electrons Connect Molecules and Electronics

## SYLLABUS, FALL 2024

Instructor: Dr. Christophe RENAULT Office Hours: Mon 5:30 to 6:30 PM Location: Flanner Hall - Room 007	e-mail: crenault@luc.edu Course Website: sakai.luc.edu
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**COURSE DESCRIPTION**

Lecture and discussion course designed to create foundational knowledge and proficiency in redox chemistry and especially electrochemistry. Topics will include thermodynamic and kinetic theory describing electron transfer, mass transport and redox catalysis.

**PREREQUISITES/COREQUISITES**

CHEM 395 and CHEM 455: CHEM 160, CHEM 180 and MATH 131 or MATH 161.

**COURSE FORMAT**

Lecture: MoWe 4:15 PM – 5:30 PM, Flanner Hall, Room 007

**PREFERRED NAME AND GENDER PRONOUN**

This course affirms people of all gender expressions and gender identities. If you prefer a different name or pronoun than what is indicated on the class roster, please let me know. Please correct me on your preferred name and gender pronouns. If you have any questions or concerns, please do not hesitate to contact me.

**OFFICE HOURS**

Office hours are for those with questions, who seek advice, want to share and/or provide feedback. You can “walk in” or make an appointment ahead of time. Discussion can be about this class and beyond – office hours are for EVERYONE. They are held on Mondays and Wednesdays at 5:30 PM in room 007 (Flanner Hall), right after the class. Specify office hours may be arranged upon request. Please contact me by email if needed.

**COMMUNICATION OUTSIDE OF CLASS TIME AND OFFICE HOURS**

Course-related communications between you and me are best conducted via email, using the Loyola email account. Avoid using personal email accounts, I may not receive those emails due to spam filters. Check your email often, AT LEAST ONCE A DAY.

**CLASS BEHAVIORAL EXPECTATIONS**

We strive for a learning environment of equity, respect, and inclusiveness. Therefore, all of us are expected to follow these basic principles:

- Demonstrate respect for oneself and for others.
- Treat others with dignity and behave in a way which promotes a physically and psychologically safe, secure, and supportive climate.
- Allow all community members to engage as full and active participants where the free flow of ideas is encouraged and affirmed.

**COURSE LEARNING OUTCOMES**

Students will deepen their understanding of foundational concepts of chemistry and advance their skills in scientific problem solving, critical thinking, and synthesis of concepts, with specific emphasis on applying mathematical models to charge transfer and transport. After successfully completing this course, students will be able to:

- Qualitatively and quantitatively describe thermodynamics of electron transfer
- Qualitatively describe kinetics of electron transfer
- Understand complex systems coupling electron transfer and mass transport
- Understand the functioning of a battery

### **CAMPUS RESOURCES**

Loyola University is dedicated to helping students succeed in their education endeavors. There are many resources to assist you with your courses. You can find brief descriptions of the various types of support with links to the respective pages, as well as quick links to each, at <https://www.luc.edu/sas>.

### **ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES**

Loyola University Chicago provides reasonable accommodations for students with disabilities. Any student requesting accommodations related to a disability or other condition is required to register with the Student Accessibility Center (SAC). Professors will receive an accommodation notification from SAC, preferably within the first two weeks of class. Students are encouraged to meet with their professor individually to discuss their accommodations. All information will remain confidential. Please note that in this class, software may be used to audio record class lectures to provide equitable access to students with disabilities. Students approved for this accommodation use recordings for their personal study only and recordings may not be shared with other people or used in any way against the faculty member, other lecturers, or students whose classroom comments are recorded as part of the class activity. Recordings are deleted at the end of the semester. For more information about registering with SAC or questions about accommodations, please contact SAC at 773-508-3700 or [SAC@luc.edu](mailto:SAC@luc.edu).

### **COURSE MATERIALS**

1. A calculator.
2. A computer to access/return homework and perform simple calculations.
3. Access to your LUC email and the course website (Sakai). Check here often for general information, announcements, discussion forums, and grades. **YOU ARE RESPONSIBLE TO BE AWARE, WITHIN 24 HOURS, OF ALL EMAILS SENT TO YOUR LUC ACCOUNT, ANNOUNCEMENTS MADE ON THE COURSE WEBSITE AND FOR ALL MATERIALS PLACED THERE.**

### **ACADEMIC CALENDAR**

You are responsible for understanding all processes and timelines associated with dropping or withdrawing from this course, file for a PASS/FAIL conversion etc. The Loyola University Chicago academic calendar that lists important dates and deadlines for the semester can be found at <https://www.luc.edu/academics/schedules>.

### **PASS/FAIL CONVERSION DEADLINES AND AUDIT POLICY**

A student may request to convert a course into or out of the "Pass/No-Pass" or "Audit" status usually only within the first two weeks of the semester (check the Academic Calendar for the actual deadline this semester). Students must submit a request for Pass/No-Pass or Audit to their Academic Advisor.

### **LATE/MISSED WORK**

Assignment deadlines are firm. Assume that technology will fail sometimes. Do not assume that everything will go smoothly when it comes to computers. Plan ahead. Do not leave completion/submission of assignments to the last possible moment. If you miss an assignment, contact the instructor as soon as possible, but not later than 48 hours after the assignment's deadline and state the reason for the missed deadline. Accommodations will be provided at the discretion of the instructor on a case-by-case basis in cases of emergency circumstances (e.g. serious illness, accidents, caring for a child or other family member).

### **ACADEMIC INTEGRITY**

Violations of Academic Integrity as a very serious offense against your fellow students and against the integrity of the university. There will be zero tolerance for infractions. If you believe there has been an infraction by someone in the class, please bring it to my attention. If caught, I will pursue disciplinary action against all parties TO THE FULLEST EXTENT POSSIBLE; this may include lowering of grades, failure, suspension or expulsion. Academic dishonesty can take several forms, including, but not limited to cheating, plagiarism, copying another student's work, and submitting false documents. Use of Artificial Intelligence to generate a document is not allowed in this class. All students in this course are expected to have read and to abide by the demanding standard of personal honesty, drafted by the College of Arts & Sciences, which can be viewed here:

<http://www.luc.edu/cas/advising/academicintegritystatement>. A basic mission of a university is to search for and to communicate the truth, as it is honestly perceived. A genuine learning community cannot exist unless this demanding standard is a fundamental tenet of the intellectual life of the community. Students of Loyola University Chicago are expected to know, to respect, and to practice this standard of personal honesty. Any instance of dishonesty (including those detailed on the website provided above or in this syllabus) will be reported to the Chair of The Department of Chemistry & Biochemistry who will decide what the next steps may be. Dishonest behavior such as any form of cheating may cause to fail (grade = 0 or "F") an assignment, examination, or the course, depending the severity of the case. That grade assigned because of cheating cannot be "dropped".

### COURSE REPEAT RULE

Effective with the Fall 2017 semester, students are allowed only THREE attempts to pass Chemistry courses with a C- or better grade. The three attempts include withdrawals (W). After the second attempt, the student must secure approval for a third attempt. Students must come to the Chemistry Department, fill out a permission to register form or print it from the Department of Chemistry & Biochemistry website: <http://www.luc.edu/chemistry/forms/> and personally meet and obtain a signature from either the Undergraduate Program Director, Assistant Chairperson, or Chairperson in Chemistry. A copy of this form is then taken to your Academic Advisor in Sullivan to secure final permission for the attempt.

### GRADING SCHEME:

Students enrolled will be evaluated based on the following:

Mode of evaluation	% of final grade	
in-class participation	25	
homework	25 (the lowest score dropped)	
Midterm	25	
Final Exam	25	

### GRADING SCALE

The following grading standards will be used (rounded to 0.1 %):

A	100 % – 92.0 %
A-	91.9 % – 88.0 %
B+	87.9 % – 84.0 %
B	83.9 % – 80.0 %
B-	79.9 % – 76.0 %
C+	75.9 % – 72.0 %
C	71.9 % – 68.0 %
C-	67.9 % – 64.0 %
D+	63.9 % – 60.0 %
D	59.9 % – 56.0 %
F	< 55.9 %

### IN-CLASS PARTICIPATION

I will regularly ask questions in class. If no one spontaneously answers then, I will randomly designate persons in the room. I will ask questions to each person (at least three times) during the entire class. You do not need to provide the correct answer to obtain participation points! I believe that incorrect answers are helpful to improve the performance

of the entire group (better to have feedback before an exam than after). If you “do not know”, it is okay. I will just expect you to explain what part of the question does not make sense so we can progress towards the answer.

### **HOMEWORK**

I will provide homework through Sakai. Two homework will be given one week before the deadline. Homework deadlines are strict. If you miss a homework deadline for a legitimate reason, contact the instructor within 48 hours of the expired deadline. Deadline extensions are entirely at the discretion of the instructor. The lowest score will be dropped. This can account for a missing homework. They are to be returned as .docx file by email at [crenault@luc.edu](mailto:crenault@luc.edu). The name of the file will be “Homework 1 –*first name*”.

### **MIDTERM AND FINAL EXAMS**

There will be one midterm, and one final exam scheduled on 10/09 and 12/11, respectively. You will have exactly 1 hour to complete the midterm and final exams. Additional time will not be granted, even if you start late. There will be no make-up final exams given under any circumstance. Individual students who have four (4) final examinations scheduled for the same date may request to have one of those exams rescheduled. If a student reports having four final examinations scheduled for the same date, students should be directed to e-mail a petition to Adam Patricoski, Assistant Dean for Student Academic Affairs, CAS Dean’s Office ([apatricoski@luc.edu](mailto:apatricoski@luc.edu)).

### **COPYRIGHT OWNERSHIP IN COURSE MATERIALS**

My lectures and course materials, including presentations, tests, exams, outlines, and similar materials, are protected by copyright. I am the exclusive owner of copyright in those materials I create. I encourage you to take notes and make copies of course materials for your own educational use. However, you may not, nor may you knowingly allow others to reproduce or distribute lecture notes and course materials publicly without my expressed written consent. This includes providing materials to commercial course material suppliers such as CourseHero and other similar services.

### **ACADEMIC GRIEVANCES AND ACADEMIC APPEALS POLICIES**

Students have the right to protection against arbitrary and capricious academic evaluations. Arbitrary and capricious means that there is no relation between the grade given and the student's performance in the class and that a reasonable person could not find that the grade was deserved. Mere disagreement or dissatisfaction with a grade does not constitute a basis for grievance. The procedure to resolve disputes can be found at: [https://www.luc.edu/academics/catalog/undergrad/reg\\_academicgrievance.shtml](https://www.luc.edu/academics/catalog/undergrad/reg_academicgrievance.shtml). Students also can request a review of circumstances that impact their academic standing or progress at the University. For example, you can appeal for a change in academic record, a finding of academic misconduct, a decision related to transfer credit, or a dismissal for poor scholarship. The procedure to request reviews can be found at <https://www.luc.edu/academics/catalog/undergrad/academicappeals>.

### **PHOTOGRAPHS, AUDIO OR VIDEO RECORDINGS**

Any photographs taken of audio or video recordings of this course or materials of this course made by you are for the students’ personal academic use only and may not be distributed in any manner (to any other individual or to the public) without written consent of the instructor (me). In this class software may be used to record live class discussions. As a student in this class, your participation in live class discussions will be recorded. These recordings will be made available only to students enrolled in the class, to assist those who cannot attend the live session or to serve as a resource for those who would like to review content that was presented. All recordings will become unavailable to students in the class when the Sakai course is unpublished (i.e. shortly after the course ends, per the Sakai administrative schedule). Students who prefer to participate via audio only will be allowed to disable their video camera so only audio will be captured. Please discuss this option with your instructor. The use of all video recordings will be in keeping with the University Privacy Statement shown below: Privacy Statement Assuring privacy among faculty and students engaged in online and face-to-face instructional activities helps promote open and robust conversations and mitigates concerns that comments made within the context of the class will be shared beyond the classroom. As such, recordings of instructional activities occurring in online or face-to-face classes may be used solely for internal class purposes by the faculty member and students registered for the course, and only during the period in which the course is offered. Students will be informed of such recordings by a statement in the syllabus for the course

in which they will be recorded. Instructors who wish to make subsequent use of recordings that include student activity may do so only with informed written consent of the students involved or if all student activity is removed from the recording. Recordings including student activity that have been initiated by the instructor may be retained by the instructor only for individual use.

**LOYOLA UNIVERSITY ABSENCE POLICY FOR STUDENTS IN CO-CURRICULAR ACTIVITIES (INCLUDING ROTC):** Students missing classes while representing Loyola University Chicago in an official capacity (e.g. intercollegiate athletics, debate team, model government organization) shall be allowed by the faculty member of record to make up any assignments and to receive notes or other written information distributed in the missed classes. Students should discuss with faculty the potential consequences of missing lectures and the ways in which they can be remedied. Students must provide their instructors with proper documentation (develop standard form on web) describing the reason for and date of the absence. This documentation must be signed by an appropriate faculty or staff member, and it must be provided as far in advance of the absence as possible. It is the responsibility of the student to make up any assignments. If the student misses an examination, the instructor is required to give the student the opportunity to take the examination at another time.

#### **ACCOMMODATIONS FOR RELIGIOUS REASONS**

If you have observances of religious holidays that will cause you to miss class or otherwise effect your performance in the class you must alert the instructor within 10 calendar days of the first-class meeting of the semester to request special accommodations, which will be handled on a case-by-case basis.

#### **NOTICE OF REPORTING OBLIGATIONS FOR RESPONSIBLE CAMPUS PARTNERS**

As an instructor, I am a Responsible Campus Partner (“RCP”) under Loyola’s Comprehensive Policy and Procedures for Addressing Discrimination, Sexual Misconduct, and Retaliation (available at [www.luc.edu/equity](http://www.luc.edu/equity)). While my goal is for you to be able to engage fully and authentically with our course material through class discussions and written work, I also want to be transparent that as a RCP I am required to report certain disclosures of sexual misconduct (including sexual assault, sexual harassment, intimate partner and/or domestic violence, and/or stalking) to the Office for Equity & Compliance (“OEC”). As the University’s Title IX office, the OEC coordinates the University’s response to reports and complaints of sexual misconduct (as well as discrimination of any kind) to ensure students’ rights are protected.

As an instructor, I also have an obligation under Illinois law to report disclosures of or suspected instances of child abuse or neglect (<https://www.luc.edu/hr/legal-notices/mandatedreportingofchildabuseandneglect/>).

The University maintains such reporting requirements to ensure that any student who experiences sexual/gender-based violence receives accurate information about available resources and support. Such reports **will not generate a report to law enforcement** (no student will ever be forced to file a report with the police). Additionally, the University’s resources and supports are available to all students even if a student chooses that they do not want any other action taken. If you have any questions about this policy, you are encouraged to contact the OEC at [equity@luc.edu](mailto:equity@luc.edu) or 773-508-7766.

If you ever wish to speak with a **confidential** resource regarding gender-based violence, I encourage you to call The Line at 773-494-3810. The Line is staffed by confidential advocates from 8:30am-5pm M-F and 24 hours on the weekend when school is in session. Advocates can provide support, talk through your options (medical, legal, LUC reporting, safety planning, etc.), and connect you with resources as needed -- *without* generating a report or record with the OEC. More information about The Line can be found at [luc.edu/wellness](http://luc.edu/wellness).

#### **REQUESTS FOR ACCOMMODATION**

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Students are encouraged to meet with their professor individually in order to discuss their accommodations. All information will remain confidential.

Please note that in this class, software may be used to audio record class lectures in order to provide equal access to students with disabilities. Students approved for this accommodation use recordings for their personal study only and recordings may not be shared with other people or used in any way against the faculty member, other lecturers, or students whose classroom comments are recorded as part of the class activity. Recordings are deleted at the end of the semester.

For more information about registering with SAC or questions about accommodations, please contact SAC at 773-508-3700 or SAC@luc.edu.

## TENTATIVE COURSE SCHEDULE

Everything in bold is graded, prepare the test, return the homework.

WEEK	Monday	Wednesday
1	08/26 Introduction of Fundamental concepts	08/28 Thermodynamics of electron transfer (ET), the Nernst Equation
2	09/02 Labor Day no class	09/04 How to measure potentials (and currents?) Introduction $i$ - $V$ , $i$ - $t$ measurements.
3	09/09 Charge distribution at the metal/electrolyte interface,	09/11 Liquid junction potential
4	09/16 Case 1: Action potential in neurons <b>Homework 1 is released on Sakai</b>	09/18 Case 2: Full battery
5	09/23 Kinetics of ET: the Butler Volmer model <b>Homework 1 must be returned</b>	09/25 Kinetics of ET: the Butler Volmer model
6	09/30 Case 3: Corrosion	10/02 Practice for exam
7	10/07 Fall break no class	10/09 <b>Midterm Exam</b>
8	10/14 Kinetics of ET: the Marcus-Husch model	10/16 From non-adiabatic to adiabatic ET
9	10/21 Mass transport at steady state	10/23 Mass transport at steady state
10	10/28 Time-dependent mass transport	10/30 Time-dependent mass transport
11	11/04 Coupled chemical reactions: EC, EC' Homework 2 is released on Sakai	11/06 Coupled chemical reactions: EC, EC' etc...
12	11/13 Case 3: Electro-catalysis <b>Homework 2 must be returned</b>	11/13 Bioelectrochemistry
13	11/18 Case 4: the glucose sensor	11/20 Photo-electrochemistry
14	11/25 Photo-electrochemistry	11/27 Thanksgiving no class

15	12/02 Focused Topics	12/04 Focused Topics
16	12/09 Practice for exam	12/11 <b>Final Exam</b>