



Form: Course Syllabus	Form Number	EXC-01-02-02A
	Issue Number and Date	2/3/24/2022/2963 05/12/2022
	Number and Date of Revision or Modification	
	Deans Council Approval Decision Number	2/3/24/2023
	The Date of the Deans Council Approval Decision	23/01/2023
	Number of Pages	06

1.	Course Title	Electrochemical Methods of Analysis
2.	Course Number	0303912
3.	Credit Hours (Theory, Practical)	3
	Contact Hours (Theory, Practical)	(3 Theory, 0 Practical)
4.	Prerequisites/ Corequisites	None
5.	Program Title	Ph.D. in Chemistry
6.	Program Code	33
7.	School/ Center	The Department of Chemistry
8.	Department	School of Graduate Studies
9.	Course Level	Department of Chemistry
10.	Year of Study and Semester (s)	Graduate/Ph.D.
11.	Other Department(s) Involved in Teaching the Course	First or second year
12.	Main Learning Language	None
13.	Learning Types	<input checked="" type="checkbox"/> Face to face learning <input type="checkbox"/> Blended <input type="checkbox"/> Fully online
14.	Online Platforms(s)	<input type="checkbox"/> Moodle <input checked="" type="checkbox"/> Microsoft Teams
15.	Issuing Date	29-9-2024
16.	Revision Date	12-10-2024

17. Course Coordinator:

Name: Prof. Dr. Mohammed Khair Hourani	Contact hours: 11:30 - 12:30 pm. Work days
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**18. Other Instructors:**

Name:

Office number:

Phone number:

Email:

Contact hours:

Name:

Office number:

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19. Course Description:

As stated in the approved study plan.

Thermodynamics of electrochemical reactions, mass transfer, kinetics of electrochemical reactions, , potentiometry, potential sweep techniques (linear sweep and cyclic voltammetry), potential step techniques (chronoamperometry and chronocoulometry), polarographic techniques, electrochemical instrumentation, stripping analysis, ultramicroelectrodes, hydrodynamic techniques (rotating disc and rotating ring-disk electrodes), modified electrodes, spectroelectrochemistry.

20. Program Intended Learning Outcomes: (To be used in designing the matrix linking the intended learning outcomes of the course with the intended learning outcomes of the program)

- SO1. Develop chemistry expertise, focus on theory and practice, and contribute to advancing knowledge in a specific research field.
- SO2. Conduct original, high-quality research that advances knowledge in chemistry by developing complex projects using innovative methodologies.
- SO3. Mentor junior researchers and students and demonstrate leadership in the scientific community through collaboration, peer review, and knowledge exchange.
- SO4. Recognize the ethical implications and responsibly use chemistry solutions to tackle global challenges.
- SO5. Participate in ongoing professional development to stay up to date with the latest research and innovations.



21. Course Intended Learning Outcomes: (Upon completion of the course, the student will be able to achieve the following intended learning outcomes)

CLO-1 Defines and explains all the thermodynamic terms and concepts of electrochemical systems and explains the relevance of the electrical quantities like the current and potential to chemical systems.

CLO-2 Defines and explains all the theoretical aspects of mass transfer and electrode kinetics.

CLO-3. Defines the terms and explains the theory of metallic electrodes, ion selective electrodes, bulk electrolysis techniques, chronoamperometry, chronocouometry, linear sweep voltammetry, cyclic voltammetry, stripping analysis, hydrodynamic techniques.

CLO-4. Explains the electrochemical instrumentation for the various electroanalytical techniques.

CLO-5 Performs the calculations for concentration and cites the applications of the various electroanalytical techniques.

Course CLOs	The learning levels to be achieved					
	Remembering	Understanding	Applying	Analysing	evaluating	Creating
CLO-1	✓	✓				
CLO-2	✓	✓	✓			
CLO-3	✓	✓	✓	✓		
CLO-4		✓	✓	✓		
CLO-5		✓	✓	✓	✓	

22. The matrix linking the intended learning outcomes of the course with the intended learning outcomes of the program:

Program SOs / Course CLOs	SO (1)	SO (2)	SO (3)	SO (4)	SO (5)
CLO-1	✓	✓	✓	✓	✓
CLO-2	✓	✓	✓		✓
CLO-3	✓		✓	✓	✓
CLO-4	✓	✓	✓		
CLO-5	✓	✓	✓		



23. Topic Outline and Schedule:

Week	Lecture	Topic	CLO/s Linked to the Topic	Learning Types (Face to Face/ Blended/ Fully Online)	Platform Used	Synchronous / Asynchronous Lecturing	Evaluation Methods	Learning Resources
1	1.1	Course Introduction	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
	1.2	Fast review of electrochemical terms, electrodes and reactions	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
	1.3	Some aspects of electrode reactions	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
2	2.1	Fast review of electrochemical terms, electrodes and reactions	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
	2.2	Static Techniques ($i=0$)	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
	2.3	Metallic electrodes and Ion selective electrodes	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
3	3.1	Advances in potentiometric instrumentation	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
	3.2	Potentiometric titrations	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
	3.3	Mass Transfer: General mass transfer theory and equation	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
4	4.1	Mass Transfer : Diffusion	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
	4.2	Kinetics of Electrode Processes	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
	4.3	Kinetic models	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
5	5.1	Implications of kinetic equations	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
	5.2	Tafel Equation and Tafel plots	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*



	5.3	Applications of Kinetics to electrochemical systems	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
6	6.1	Potential-Step Techniques: Theory	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
	6.2	Chrono-amperometry	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
	6.3	Chrono-coulometry	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
7	7.1	Applications of Chronoamperometry and chronocoulometry	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
	7.2	Potential Sweep Techniques: Theory	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
	7.3	Linear Sweep voltammetry	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
8	8.1	Cyclic voltammetry	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
	8.2	Applications of cyclic voltammetry	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
	8.3	Stripping Analysis	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
9	9.1	Stripping Analysis	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
	9.2	Ultramicroelectrodes: basics	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
	9.3	Ultramicroelectrodes: theory	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
10	10.1	Ultramicroelectrodes: applications	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
	10.2	Bulk electrolysis techniques: basics	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
	10.3	Bulk electrolysis techniques : Theory	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
11	11.1	Bulk electrolysis techniques	1 - 5	FF			Quizzes, exams, HomeWorks, presentations, term papers ,	B,L,O, H*
	11.2	Bulk electrolysis techniques: electrometric end point detection	1 - 5	FF			Quizzes, exams, homeworks,presentations, termpapers ,	B,L,O, H*
	11.3	Applications of bulk electrolysis techniques	1 - 5	FF			Quizzes, exams, homeworks,presentations, termpapers ,	B,L,O, H*
12	12.1	Electrochemical instrumentation: an overview	1 - 5	FF			Quizzes, exams, homeworks,presentations, termpapers ,	B,L,O, H*



	12.2	Electrochemical instrumentation	1 - 5	FF			Quizzes, exams, homeworks, presentations, term papers ,	B,L,O, H*
	12.3	Operational amplifiers circuits	1 - 5	FF			Quizzes, exams, homeworks, presentations, term papers ,	B,L,O, H*
13	13.1	Potentiostats and galvanostats	1 - 5	FF			Quizzes, exams, homeworks, presentations, term papers ,	B,L,O, H*
	13.2	Potential control problems	1 - 5	FF			Quizzes, exams, homeworks, presentations, term papers ,	B,L,O, H*
	13.3	Dealing with small currents	1 - 5	FF			Quizzes, exams, homeworks, presentations, term papers ,	B,L,O, H*
14	14.1	Classical polarographic analysis	1 - 5	FF			Quizzes, exams, homeworks, presentations, term papers ,	B,L,O, H*
	14.2	Normal pulse polarography	1 - 5	FF			Quizzes, exams, homeworks, presentations, term papers ,	B,L,O, H*
	14.3	Differential pulse polarography	1 - 5	FF			Quizzes, exams, homeworks, presentations, term papers ,	B,L,O, H*
15	15.1	Differential pulse voltammetry	1 - 5	FF			Quizzes, exams, homeworks, presentations, term papers ,	B,L,O, H*
	15.2	Hydrodynamic Voltammetry : basics	1 - 5	FF			Quizzes, exams, homeworks, presentations, term papers ,	B,L,O, H*
	15.3	Rotating disc electrode	1 - 5	FF			Quizzes, exams, homeworks, presentations, term papers ,	B,L,O, H*

* Text books, lecture notes, open resources and handouts.

24. Evaluation Methods:

Opportunities to demonstrate the achievement of the CLOs are provided through the following assessment methods and requirements:

Opportunities to demonstrate the achievement of the CLOs are provided through the following assessment methods and requirements:					
Evaluation Activity	Mark	Topic(s)	CLOs	Period (Week)	Platform
Midterm exam	30	Electrochemical thermodynamics, Potentiometric techniques, mass transfer, kinetics of electrode processes, potential step techniques	CLO-1 to CLO-5	8 weeks	
Quizzes	10	At the end of each unit	CLO-1, CLO-2, CLO-3	Every couple of weeks	



Homeworks	5	After finishing each unit	CLO-1, CLO-2, CLO-5	Almost weekly	
Seminars	15	2 weeks before the end of the semester	CLO-1 and CLO-4	1 at the semester	
Final	40	At the end of the semester	CLO-1 to CLO-5		

25. Course Requirements:

(e.g: students should have a computer, internet connection, webcam, account on a specific software/platform...etc):

1. Laptop for Power Point Presentation and Videos.
2. Data Show for Power Point Presentation.
3. Internet connection
4. Screen
5. Some laboratory equipment for demonstrations

26. Course Policies:

A- Attendance policies:

Attending the course is mandatory. Failure to sit an exam will result in a mark of zero, unless a valid reason (with supporting documentation) for the absence is presented.

B- Absences from exams and handing in assignments on time:

Proof of illness requires a signed medical certificate. Notify me as soon as possible if you are going to miss an exam. If any course component is missed for a valid reason, that portion of the exam grade will/may be shifted to the final examination.

C- Health and safety procedures:

Special Needs Students: Feel free to inform your instructor of your special needs in order for you to have a productive learning experience.

D- Honesty policy regarding cheating, plagiarism, misbehavior:

When writing a report or paper on a given topic, you must read up the necessary information on the topic, and then present it in your own words and writing. If you want to use an exact



sequence of text or an idea or data from someone else's work, that is considered a quote, then that work must be cited (you must give a proper credit to the author) specifically as a reference. Therefore, if you are caught cheating on any component of Chem.741 you will be assigned a grade of zero for the course. We shall also place a letter describing the offense in your student file.

If you see someone cheating during an exam or writing a paper or report, inform us/the proctors in the following ways: 1) Write a short message on your exam paper or report indicating what is happening. 2) Raise your hand and the proctor or myself will come over – then let us know and point out your note; we will take it from there.

It is important to point out that there is a difference between plagiarism and working out answers to a lab report or an assignment with a friend. If your writing is based on your own words and your understanding of the material, then that is acceptable. If, however, you simply write your friend's thought or answer, i.e. the same thing (cut and paste), then you have committed plagiarism. Simply, plagiarism is cheating; if you are unclear about any part of this issue or have any question, please speak up and let me know.

E- Grading Scheme and policy:

Assignments are due at the beginning of the class, unless otherwise specified.

Assignments, and suggested problems are intended as partial preparation for exams. Failure to put forth effort is perilous.

F- Available university services that support achievement in the course:

- E-Learning resources
- Computer resources
- Computer and a Data Show

27. References:

A- A- Required book(s), assigned reading and audio-visuals:

• Textbook :

Bard, A., Faulkner, L., Electrochemical Methods; Fundamentals and Applications, White, Henry, 3rd ed, Wiley New York , 2022.

Kissinger, P., Heiman, W.(Eds) Laboratory Techniques in Electroanalytical Chemistry, CRC, New York, 1996.

- Lecture notes
- Handouts

B- Recommended books, materials, and media:

1. Bockris, J. O.M. and Khan, S. U. M , Surface Electrochemistry, Plenum press, New York, 1993.



2. Brett, C. M. A and Brett, A. M. O, Electrochemistry: Principles, Methods, and Applications, Oxford University Press, Oxford, 1993.
3. Chrestensen, P. A., and Hammett, A. , *Techniques and Mechanisms in Electrochemistry*, Blackie Academic and Professional, Glasgow, 1994.
4. Crow, D. R., *Principles and Applications of Electrochemistry*, 3rd Edition, Chapman and Hall, London, 1988.
5. Gileadi, E. *Electrode Kinetics for Chemists, Chemical Engineering and Materials Scientists*, VCH, New York, 1993.
6. Kissinger, P. T. and Heinman, W. R, Eds. *Laboratory Techniques in Electroanalytical chemistry*, 2^{ed} Edition, Dekker, New York, 1996.
7. Koryata, J. Dvorak, J. and Kavan, L. *Principles of Electrochemistry*, Second Edition, Wiley, New York, 1993.
8. Oldham, K. B. and Myland, J. C., *Fundamentals of Electrochemical Science*, Academic Press, San Diego, 1994.
9. Reieger, P. H., *Electrochemistry*, 2^{ed} Edition, Chapman and Hall, New York, 1994.
10. Sawyer, D. T. , Sobkowski, A., and Roberts, J.L., Jr, *Electrochemistry for Chemists*, 2^{ed} Edition, Wiley-Interscience, New York, 1995.
11. Wang, J. , *Analytical Electrochemistry*, VCH, New York, 1994.
12. Compton, R. G., and Hammett, M. A., eds. *New Techniques for the study of Electrodes and their Reactions*, Volume 29, Elsevier, Amsterdam, 1989.
13. Goodisman, J., *Electrochemistry : Theoretical Foundations*, Wiley, New York, 1987.
14. Gutierrez, C. and Melendez, C. eds., *Spectroscopic and Diffraction Techniques in Electrochemistry*, kluwer, Boston, 1988.



15. Lipkowski, J., and Ross, P. N., eds. *Structure of Electrified Interfaces*, VCH, New York, 1993.
16. Rubenstein, I., ed., *Physical Electrochemistry*, Dekker, New York, 1995.
17. Varma, R. , and Selman, J. R., eds. *Techniques for Characterization of Electrodes and Electrochemical Processes*, Wiley, New York, 1991.
18. Vijih, A. K., *Electrochemistry of Metals and Semiconductors*, Dekker, New York, 1973.
19. Bard, A. J., Parsons, R. and Jordan, J., eds., *Standard Potentials in Aqueous solution*, Dekker, New York, 1985.
20. Bockris, J. O'M., ed., *Comprehensive Treatise of Electrochemistry*, Plenum Press, New York, 1980 (All volumes).
21. Gerischer, H. ed., *Advances in Electrochemistry and Electrochemical Engineering*, Wiley-Interscience, New York, 1961 (All volumes).
22. Bond, A. M., *Modern Polarographic Methods in Analytical Chemistry*, Dekker, New York, 1980.
23. Durst, R. A., ed., *Ion-Selective Electrodes*, National bureau of Standards, Special Publication 314, Washington, 1969.
24. Freezer, H., ed., *Ion-Selective Electrodes in Analytical Chemistry*, Plenum Press, New York, 1980.
25. Koryata, J. , *Ions, Electrodes, and Membranes*, New York, 1982.
26. Koryata, J., and Stulik, K., *Ion-Selective Electrodes*, Cambridge University Press, London, 1983.
27. Morrison, S. R. , *Electrochemistry at Semiconductor and Metal Oxide Electrodes*, Plenum Press, New York, 1980.
28. Pletcher, D. *Industrial Electrochemistry*, Chapman and Hall, London, 1982.
29. Serjeant, E. P., *Potentiometry and Potentiometric Titrations*. Wiley, New York, 1984.



28. Additional information:

None

Name of the Instructor or the Course Coordinator: Signature: Date:

Prof. Dr. Mohammed Khair Hourani..... *mohd Hourani* 12-11-2024

The Head of Graduate Studies Committee/
Department Chemistry
Dr. Murad AIDamen, Prof. **Signature:** **Date:**

The Head of Department of Chemistry
Dr. Murad AIDamen, Prof. **Signature:** **Date:**

Vice Dean for Graduate Studies and Scientific
Research / School of Science
Dr. Kamal Sweidan, Prof. **Signature:** **Date:**

The Dean of School of Science
Dr. Mahmoud I. Jaghoub, Prof. **Signature:** **Date:**