



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
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	Number of Pages	06

1.	Course Title	Electroanalytical Chemistry
2.	Course Number	0333312
3.	Credit Hours (Theory, Practical)	3,0
	Contact Hours (Theory, Practical)	3,0
4.	Prerequisites/ Corequisites	0343311
5.	Program Title	B.Sc. in Chemistry
6.	Program Code	33
7.	School/ Center	Science
8.	Department	Chemistry
9.	Course Level	3 rd year
10.	Year of Study and Semester (s)	Third year
11.	Other Department(s) Involved in Teaching the Course	None
12.	Main Learning Language	English
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 type="checkbox"/> Microsoft Teams
15.	Issuing Date	End of Second Semester/ 23-24
16.	Revision Date	1-10-2024

17. Course Coordinator:

Name: Prof. Dr. Mohammed Khair Hourani	Contact hours: 11:30 – 12:30 p.m. all days
Office number: 11, Chemistry Annex	Phone number: 11240
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**18. Other Instructors:**

Name:

Office number:

Phone number:

Email:

Contact hours:

Name:

Office number:

Phone number:

Email:

Contact hours:

19. Course Description:

As stated in the approved study plan.

1. Introduction to Electrochemistry

Oxidation-reduction reactions, characterizing oxidation/reduction reactions, electrochemical cells, electrode potentials, standard electrode potentials, factors which affect electrode potentials, limitations to the use of standard electrode potentials, formal potentials.(Chap. 18,)

2. Applications of Standard Electrode Potentials

Calculations of Potentials of Electrochemical Cells, experimental determination of standard electrode potentials, calculation of equilibrium constants for redox reactions, ,basic principles of redox titrations , titration curves for redox titrations, variables which affect the titration curve, indicators for redox titrations, potentiometric endpoint detection, calculations in redox titrations. (Chap. 19)

3. Applications of Oxidation/Reduction Titrations.

Auxiliary oxidizing (pre-oxidants) and auxiliary reducing agents (pre-reductants), auxiliary oxidizing agents, auxiliary reducing agents, applications of standard reducing agents, applications of standard oxidizing agents, Karl Fisher reagent for determination of water. (Chap. 20).

4. Potentiometric methods

Electrochemical cells and liquid junction potentials, metallic electrodes, ion selective electrodes, types of membranes, pH electrode, calcium electrode, fluoride electrodes, molecular electrode systems, enzyme electrodes, modes of measurements, instrumentation, applications (Chap. 21).



5. Bulk Electrolysis: Electrogravimetry and Coulometry

Theory of electrogravimetry and coulometry, Electrogravimetric analysis basic principles, ideal conditions of precipitation of nonflacky, nonpowdery, nonspongy deposits, instrumentation of electrogravimetric analysis, calculations of electrogravimetric analysis, basic theory of coulometry, types of coulometry, instrumentation of coulometric analysis, current efficiency, strategies for maintaining current efficiency, calculations of coulometric analysis) (Chap. 22).

6. Voltammetric analysis

Basic principles of voltametric analysis, classification of voltametric techniques, modes of mass transfer, linear sweep and cyclic voltammetry, the voltammogram, how to read a voltammogram, systems of lotting the voltametric data. (Chap 23).

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)

- SO-1. Problem Solving: Graduates will be able to apply mathematical and scientific knowledge to identify, formulate, and solve technical or scientific problems relevant to the discipline of chemistry.
 - SO-2. Design: Graduates will be able to use their understanding of chemistry concepts and principles to formulate and design systems, processes, procedures, or programs to meet desired goals and outcomes.
 - SO-3. Experimental Skills: Graduates will be able to design, conduct, and analyze experiments or test hypotheses, utilizing appropriate chemical techniques and scientific judgment to draw meaningful conclusions.
 - SO-4. Communication: Graduates will be able to communicate scientific information effectively and accurately to a range of audiences, including both technical and non-technical audiences.
 - SO-5. Ethics and Global Context: Graduates will understand and apply ethical and professional responsibilities in the context of the impact of technical and scientific solutions on global, economic, environmental, and societal issues.
 - SO-6. Teamwork: Graduates will be able to work effectively as part of a team, establishing goals, planning tasks, meeting deadlines, and analyzing risk and uncertainty in the context of chemistry-related projects and initiatives.
- Handling Chemicals: An ability to apply the proper procedures for safe handling of chemicals

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 terms and aspects of redox reactions and redox reactions terminology.
- CLO-2. Defines and explains all the terms and processes involved in the electrochemical cells and manages the calculations relating the redox reactions to thermodynamic functions.



CLO-3. Defines the terms and explains the theory and design of potentiometric devices and manages related calculations and expected errors and error sources.

CLO-4. Defines the terms and explains the theory, instrumentation and calculations in potentiometric analysis, electrogravimetry and coulometry, voltammetric techniques.

CLO-5. Explains the applications of potentiometric analysis, electrogravimetry and coulometry, and voltammetry.

CLO-6. Manages interpretation of the data and calculations related to potentiometry, electrogravimetry and coulometry and voltammetric analysis.

Course ILOs	The learning levels to be achieved					
	Remembering	Understanding	Applying	Analysing	evaluating	Creating
CLO-1	✓					
CLO-2	✓	✓	✓	✓	✓	✓
CLO-3	✓	✓		✓	✓	
CLO-4	✓	✓	✓	✓		✓
CLO-5	✓		✓		✓	
CLO-6		✓		✓	✓	✓

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

Program ILOs / Course ILOs	ILO (1)	ILO (2)	ILO (3)	ILO (4)	ILO (5)	ILO(6)
1	✓	✓	✓	✓		
2	✓	✓	✓	✓		
3	✓	✓	✓	✓	✓	✓
4	✓		✓		✓	✓
5	✓	✓		✓		✓
6	✓	✓	✓		✓	

23. Topic Outline and Schedule:



Week	Lecture	Topic	ILO/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	Introduction to electrochemistry	CIO-1	Face-to-face	-	-	Exams, quizzes and homeworks	Book, lecture notes
	1.2	Applications of Electrochemistry	CIO-1, CIO-2	Face-to-face			Exams, quizzes and homeworks	Book, lecture notes
	1.3	Electroanalysis	CLO-1, CLO 2	Face to Face			Exams, quizzes and homeworks	Book, lecture notes
2	2.1	Oxidation-reduction reactions	1,2,3	F-to-F			Exams, quizzes and homeworks	Book, lecture notes
	2.2	Electrochemical cells	1,2,3,4	F-to-F				Book, lecture notes and videos
	2.3	Electrode reactions						
3	3.1	Quantitative aspects of electrolysis	1,2,4,5	F-to-F			Exams, quizzes and homeworks	Book, lecture notes
	3.2	Cell and electrode potential	1,3,4	F-to-F			Exams, quizzes and homeworks	Book, lecture notes
	3.3	Redox titrations						
4	4.1	Calculation of equilibrium constants	1,3,4,5	F-to-F			Exams, quizzes and homeworks	Book, and lecture notes
	4.2	Redox titrations	2,3,4,5	F-to-F			Exams, quizzes and homeworks	Book, and lecture notes



	4.3	Derivation of titration curve	1,3,5,6	F-to-F			Exams, quizzes and homeworks	Book, and lecture notes
5	5.1	Indicators	1,2,3	F-to-F			Exams, quizzes and homeworks	Book, lecture notes
	5.2	Applications: auxiliary reagents	2,3	F-to-F			Exams, quizzes and homeworks	Book, lecture notes
	5.3	Redox titrations: General calculations					Exams, quizzes and homeworks	Book, lecture notes
6	6.1	Standard reductants					Exams, quizzes and homeworks	Book, lecture notes
	6.2	Standard oxidants					Exams, quizzes and homeworks	Book, lecture notes
	6.3	Karl Fisher reagent					Exams, quizzes and homeworks	Book, lecture notes
7	7.1	Classification of instrumental electrochemical techniques					Exams, quizzes and homeworks	Book, lecture notes
	7.2	Potentiometry: theory					Exams, quizzes and homeworks	Book, lecture notes
	7.3	Metallic electrodes					Exams, quizzes and homeworks	Book, lecture notes
8	8.1	Ion-selective electrodes: basic principles					Exams, quizzes and homeworks	Book, lecture notes
	8.2	pH electrode : theory					Exams, quizzes and homeworks	Book, lecture notes
	8.3	Calcium and fluoride electrodes					Exams, quizzes and homeworks	Book, lecture notes
9	9.1	Gas sensing probes					Exams, quizzes and homeworks	Book, lecture notes



	9.2	Biosensors				Exams, quizzes and homeworks	Book, lecture notes
	9.3	Instrumentation of ion-selective electrodes				Exams, quizzes and homeworks	Book, lecture notes
10	10.1	Practical aspects of potentiometry: modes of measurements				Exams, quizzes and homeworks	Book, lecture notes
	10.2	Ion-selective electrodes: applications				Exams, quizzes and homeworks	Book, lecture notes
	10.3	Bulk electrolysis techniques: general theory				Exams, quizzes and homeworks	Book, lecture notes
11	11.1	Electrogravimetry				Exams, quizzes and homeworks	Book, lecture notes
	11.2	Coulometry				Exams, quizzes and homeworks	Book, lecture notes
	11.3	Practical aspects of electrogravimetry and coulometry				Exams, quizzes and homeworks	Book, lecture notes
12	12.1	Applications of electrogravimetry and coulometry				Exams, quizzes and homeworks	Book, lecture notes
	12.2	Electrogravimetry and Coulometry: calculations				Exams, quizzes and homeworks	Book, lecture notes
	12.3	Voltammetry : general theory				Exams, quizzes and homeworks	Book, lecture notes
13	13.1	Modes of mass transfer				Exams, quizzes and homeworks	Book, lecture notes
	13.2	Kinetics of electrode reactions				Exams, quizzes and homeworks	Book, lecture notes
	13.3	Linear sweep voltammetry : theory				Exams, quizzes and homeworks	Book, lecture notes



14	14.1	Linear sweep voltammetry : applications				Exams, quizzes and homeworks	Book, lecture notes
	14.2	Cyclic voltammetry: theory				Exams, quizzes and homeworks	Book, lecture notes
	14.3	Voltammogram interpretation				Exams, quizzes and homeworks	Book, lecture notes
15	15.1	Cyclic voltammetry for reversible systems				Exams, quizzes and homeworks	Book, lecture notes
	15.2	Cyclic voltammetry for irreversible systems				Exams, quizzes and homeworks	Book, lecture notes
	15.3	Applications				Exams, quizzes and homeworks	Book, lecture notes

24. Evaluation Methods:

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

Evaluation Activity	Mark	Topic(s)	ILO/s Linked to the Evaluation activity	Period (Week)	Platform
Quizzes	5	All	CLO-1 through CLO-6	Weekly (average)	In class
Midterm	30	Oxidation reduction reactions, electrochemical cells , redox titrations and applications	1 - 6	After 7 weeks	In class
Exam II		Potentiometry and bulk electrolysis techniques	1-6	After 13 weeks	



Final	50	All of the material	1-6	At the end of the semester	In class

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 demonstration

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

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

- **Textbook** : D. Skoog, F. Holler and S. Crouch, Fundamentals of Analytical Chemistry, , 9th edition , Thomson/Brooks/Cole, New York, 2014.
- Lecture notes
- Handouts

A- B- Recommended books, materials, and media:

1. محمدخير الحوراني : الكيمياء الكهروتحليلية، الطبعة الثانية دار الضياء ، عمان (2010).



28. Additional information:

None

Name of the Instructor or the Course Coordinator: Prof. Dr. Mohammed Khair Hourani
Signature: *Moh'd Hourani* Date: Oct. 1, 2024

Name of the Head of Quality Assurance Committee/ Department	Signature:	Date:
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Name of the Head of Department	Signature:	Date:
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Name of the Head of Quality Assurance Committee/ School or Center	Signature:	Date:
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Name of the Dean or the Director	Signature:	Date:
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