Course Specification
(Bachelor)

Course Title:	ElectrochemistryAdvanced
Course Code:	CHM345
Program:	Chemistry
Department:	Chemistry
College:	College of Sciences Al Zulfi
Institution:	Majmaah University
Version:	TP-153
Last Revision Date:	12/10/2024

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (.....)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (.....2nd Level/ 1st Year ....)					
4. Course General Description:					
This course covers the fundamentals of electrochemistry, practical electrochemical methods, and applications of electrochemistry in modern technology with the focus on energy storage technologies. Electrochemistry is a field of science that describes the interrelation of chemical and electrical effects. Much of the field deals with describing how chemical changes are caused by the passage of electrical current or how the production of electrical current can be caused by chemical reactions. Electrochemists rely on a foundational understanding of thermodynamics, electron transfer kinetics, and mass transport phenomena – each of which are treated in detail in this course in the context of understanding electrochemical phenomena. Electrochemical impedance spectroscopy will be discussed and the fundamental theory applied to practical applications. Students will also be exposed to laboratory and computer simulation projects.					
5. Pre-requirements for this course (if any)**:**					
Electrochemistry, CHM 242					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					
- **Study the electrolyte double layer and electro kinetic effects, theoretical studies of the double layer, electrical potential and current, The migration of ions and Free energy and the electrolysis, fuel cells, polarization and overpotential, Butler-Volmer equation and Tafel equation.** - **Study The deposition and corrosion of metals, Theories of corrosion -Electrochemical mechanism of corrosion -factors affecting corrosion – passivity – Flade potential - Pourbiax diagrams -Inhibitors, protection of metals and Electro kinetic phenomena.**					

- **Study the methods of applying metallic coating, Classification of Metallic coating, Electroplating, Electroplating, Data Interpretation, Reversible Systems, Irreversible and Quasi-reversible systems,**
- **Reaction Mechanisms and the Impedance Spectroscopy.**

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	3H	70%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		30%
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	**26**
2.	**Laboratory/Studio**	**10**
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		**Total**

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Knowledge about the electrolysis, fuel cells, polarization and over potential, Butler-Volmer equation, Tafel equation, electrolyte double layer,	K1	Lectures Class discussion	Written Midterm Final examinations

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.2	Explain the Impedance Spectroscopy, Principles and Applications and Differentiate between the deposition metallic coating, and corrosion of metals	K2	Lectures Class discussion	Written Midterm Final examinations
2.0	**Skills**			
2.1	Solve the unexpected problems by creative ways	S2	Lectures Class discussion Lectures Class discussion	Written Midterm Final examinations Written Midterm Final examinations
2.2	Apply the skills acquired in the academic and professional contexts related to the science of chemistry.	S3		
3.0	**Apply the appropriate mathematical formula to solve problems relating to course concept**			
3.1	Choose the suitable method to solve problems	V1	Lectures Class discussion	Written Midterm Final examinations
3.2				
...				

C. Course Content

No	List of Topics	Contact Hours
1.	The electrolyte double layer and electro kinetic effects, theoretical studies of the double layer, electrical potential and current, The migration of ions and Free energy.	4
2.	The electrolysis, fuel cells, polarization and over potential, Butler-Volmer equation and Tafel equation.	4
3.	The mechanism of the electrode processes	4
4.	The deposition and corrosion of metals, Theories of corrosion -Electrochemical mechanism of corrosion -factors affecting corrosion – passivity – Flade potential - Pourbaix diagrams -Inhibitors, protection of metals. Electrokinetic phenomena	6
5.	Electroplating with more noble metal metals, electroplating with less noble metal metals, and Electroplating of some industrial important alloys	2
6.	The linear & cyclic Voltammetry, Data Interpretation, Reversible Systems, Irreversible and Quasi-reversible Systems, Study of Reaction Mechanisms	4

7.	Impedance Spectroscopy Principles and Applications.	4
8.	Practical part: 1. ***Determination of copper by electroplating method on anode electrode*** 2. ***CYCLIC VOLATMETRY METHOD*** 3. ***ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY***	10
Total		**38**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Homework	Continues	5%
2.	Quizzes	End of topic	5%
3.	Practical exam	One/semester	20%
4.	First midterm exam	6th	10%
5.	Second midterm exam	9th	10%
6.	E. exam	10th	10%
	Final Theoretical exam	15th	40%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	1. Advanced Electrochemistry , Interfaces, thermodynamics, and electrochemical techniques, Andrzej Lasia, Département de chimie Université de Sherbrooke, 2014. 2. Advanced Electrochemistry , Dr. Marshal Dhayal, India, American Scientific Publishers, 2014, Volume 2 Vol. 2, No. 1 (June 2014),2013, Volume 1,Vol. 1, No. 2 (August 2013),Vol. 1, No. 1 (April 2013) . 3. Introduction to Corrosion Science , Edward McCafferty, Springer, ; 1st Edition. edition (2010). 4. Corrosion Chemistry, Volkan Cicek and Bayan Al-Numan, Wiley-Scrivener, 1st edition (2011). 5. The Physical Chemistry Of The Metals, Friedrich Rudolf Schenck, Read Books, January 31, 2008.
Supportive References	List Required Textbooks Physical Chemistry, 11th ed. Peter Atkins and etc. Oxford University Press,2018 ISBN-13: 978-0198769866

	Analytical Electrochemistry ,3th edition, Wang ,Joseph, JohnWiley &Sons,New Jersy, Canada, 2006. 2.. Electrochemistry, Carl H. Hamann , Andrew Hamnett, JohnWiley &Sons, 2007.
Electronic Materials	**http://www.springer.com/materials/journal/12613** **websites:** **http://pogil.org** **http://www.pcrest.com/PC/pub/index.htm** **http://faculty.mu.edu.sa/m.salem**
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classrooms, E- learning, blackboard
Technology equipment (projector, smart board, software)	data show, Smart Board
Other equipment (depending on the nature of the specialty)	None

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Extent of achievement of course learning outcomes	Direct
Effectiveness of Students assessment	Instructor	Direct assessment sheet
Quality of learning resources	Extent of achievement of course learning outcomes	Direct
The extent to which CLOs have been achieved	Instructor	Direct assessment sheet
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**CHEMISTRY DEPARTMENT COUNCIL**
REFERENCE NO.	**16**

DATE	**12/10/2024**