Course Specification
(Bachelor)

Course Title:	Electrochemistry and Corrosion
Course Code:	CHM 1243
Program:	Bachelor of Science in Chemistry
Department:	Chemistry
College:	Science
Institution:	Imam Mohammed Ibn Saud Islamic University
Version:	1
Last Revision Date:	*Pick Revision Date.*

Table of Contents

A. General information about the course:

-1. Course Identification

1. Credit hours: 3 (2, 0, 3)					
3 (2 Lectures, 0 Tutorials, 3 Lab)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐ Elective		
3. Level/year at which this course is offered: Level 4 / year 2					
4. Course general Description:					
Topics covered in the course include the fundamentals of electrochemistry, cells, batteries and their standard potentials, Nernst equation, potentiometry and voltammetry methods, electrolytic conductance, corrosion					
5. Pre-requirements for this course (if any)**:**					
Physical Chemistry (1) –CHM 1241					
6. Co-requisites for this course (if any)**:**					
None					
7. Course Main Objective(s):					

- At the end of the course, Students should be able to:
- **To provide students with basics of electrochemical processes under standard and non-standard conditions.**
- **To familiarize students with the principles of some electrochemical techniques.**
- **To introduce corrosion and wear occurring to metals under different conditions.**
- **To give summary of different technologies are used to prevent or minimize corrosion.**
- **Solve mathematical problems to calculate cells potentials, amounts of metal deposited in electrolysis, conductivity, resistivity and current values.**
- **Carry out experiments, collect data and derive relations and conclusions.**

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	75	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	**30**
2.	**Laboratory/Studio**	**45**
3.	**Field**	**0**
4.	**Tutorial**	**0**
5.	**Others (specify)**	**0**
Total		**75**

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

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**To recognize some principles of electrochemistry.**	**K1; K2; K3**	**Lecture**	**Short quizzes**
1.2	**To state Nernst equation for a galvanic cell potential due to change of redox system.**	**K1; K2; K3**	**Lecture and laboratory experiments**	**Exams and lab reports**
1.3	**To name laws of conductivity, resistivity and related phenomena.**	**K1**	**Group discussions and laboratory experiments**	**Oral test and lab reports**

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
1.4	To define corrosion and its impact upon metal integrity, and list methods of corrosion prevention	K1; K3; K4	Lecture, homework and laboratory experiments	▪ Homework assignment marks and lab reports
2.0	Skills			
2.1	To evaluate the equilibrium constant from experimental data, and contrast kinetic data with Mathematical equations.	S1; S2; S3	Lectures and laboratory experiments	Solved problem marks Short quizzes and Laboratory reports Numerical problem
2.2	To analyze data and results through analytical thinking, with evaluation of the gained information.	S1; S2; S3	, Brain storming and self-study	Work portfolio and homework
2.3	To demonstrate skills to participate in class by asking questions and giving answers.	S3	Motivate students to ask questions and to give response.	Participation marks
2.4	To interpret experimentally obtained data and present orally, and writing of mini-Reports using electronic mail and Networks in communicating with others	S2; S4,	• Seminars • Group discussions and lab experiment • Group discussion and assignments • Encourage students to use electronic mail to submit works and assignements.	• Presentation marks • Oral tests and lab sheets • Oral test and assignments marks • Assignments and homework • Laboratory performance ▪ Laboratory reports and

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
			• Virtual labs and demonstrations	sheet
3.0	Values, autonomy, and responsibility			
3.1	To appraise effectively the collaboration and inter-professionalism in class discussions or team works.	V1, V2	• Group discussions and lab experiment • Homework • Mini reports Virtual labs and demonstrations	• Presentation marks. • Oral tests and lab sheets • Assessments and homework Laboratory reports and sheet

C. Course Content

No	List of Topics	Contact Hours
1.	Introduction / Fundamental Concepts: Electrochemistry and Redox, Redox Review. Balancing Redox Reactions, Types of cells, Common Components, Electrolytic cells, Voltaic (Galvanic) Cells, Cell Potential. STANDARD POTENTIALS, Standard Reduction Potentials, E0cell and ΔG0, Calculating E0 cell, Nernst equation, Concentration Cells. Batteries, Fuel Cells, Electrolysis, Stoichiometry, Faraday constant (F).	6
2.	Practical Considerations: Electrochemical Cell, electroanalytical measurement, Potentiometric Technique, Potentiostatic Technique, voltammogram. Thermodynamics and Potentials. Ion-selective electrodes (ISE), glass electrodes, liquid membrane electrodes, solid-state electrodes, applications of ISEs. Steps in simple reactions, steps in complex reactions, electrode reaction pathway, reactions controlled by mass transport.	6
3.	Potentiometry: Potential step experiments, potential sweep experiments. Reactions controlled by rate of electron transfer, electrical double layer. Reactions & Interfacial Properties:Cyclic voltammetry, Reversible Systems, Irreversible Systems, Quasi-reversible Systems, Applications, spectroelectrochemistry, electrochemiluminescence (ecl), scanning probe microscopy.	6
4.	Scanning tunneling microscopy (stm), atomic force microscopy (afm), scanning electrochemical microscopy (secm), electrochemical quartz crystal, microbalance (eqcm), impedance spectroscopy. Controlled potential techniques: Controlled potential, chronoamperometry, chronocoulometry, polarography, the ilkovic equation, pulse voltammetry, ac voltammetry, stripping analysis, flow analysis.	6

5.	Chemical Corrosion: Electrochemical Corrosion, the Electrode Potential in Electrochemical Cells. Types of Electrochemical Corrosion, Protection Against Electrochemical Corrosion.	6
Total		30

No	List of Experiments	Contact hours
1	Electrolysis of Water	3
2	Electrochemical Studies on Different Galvanic Cells	3
3	Electrochemical Studies on Concentration Cells.	3
4	Electroplating.	3
5	Determination Of Cell Constant.	3
6	Part1: Determination of Equivalent Conductance of a Strong Electrolyte.	3
7	Part2: Dissociation Constant of Weak Acid.	3
8	Part1: Solubility product K_{sp} by conductivity method	3
9	Part2: Determination of ΔG, ΔH and ΔS by solubility product method	3
10	Calculate the equilibrium constant electrochemically	3
11	Corrosion rate (weight loss), Corrosion Inhibition	6
12	Corrosion rate (corrosion current)	3
13	Potentiometric Titration of a Bromide-Iodide Mixture	3
14	Revision	3
Total		45

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm 1	Around 6th & 7th week	10%
2.	Midterm 2	Around 11th & 12th week	10%
3.	Quizzes, Homeworks, class participation, and mini projects	During the semester	10 %
4.	Laboratory	All the semester	30 %
5.	Final Exam	Around 16-17th week	40 %
6.	Total		100 %

*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	***Analytical Electrochemistry***, Joseph Wang, 3rd Ed., 2006, John Wiley & Sons, New Jersy, ISBN: 978-0-471-67879-3. ***Solution Manual for Quantitative Chemical Analysis***, 8th Daniel C. Harris, W. H. Freeman, 2010, ISBN-13 : 978-1429231237
Supportive References	• ***Electrochemical Methods: Fundamentals and Applications***, A. J. Bard and L. R. Faulkner, 2nd Ed., 2001, John Wiley & Sons, New York, ISBN: 0-471-04372-9. • ***The Science and* Engineering *of Materials,*** *Donald R. Askeland – Pradeep P. Phulé, , 4th ed. (req. for corrosion part, Chapter 22)* ***Experimental Electrochemistry: A Laboratory Textbook,*** *R. Holze 1st Ed., (2009), Wiley-VCH. ISBN-13: 978-3527310982*
Electronic Materials	• **Blackboard** • **http://highered.mcgrawhill.com/classware/ala.do?isbn=0073048518&alaid=ala_1136810&protected=true&showSelfStudyTree=true** • **http://www.chem1.com/acad/webtext/virtualtextbook.html** **http://www.shodor.org/UNChem/index.html**
Other Learning Materials	· **None**

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• **Each of the class room should be equipped with a whiteboard and a projector, with a maximum of 20 students.** • **In each laboratory, a list of safety and precautions are provided.** • **In each lab has proper ventilation, and well equipped with instruments.** • **In each lab, containers for solid waste, liquid waste, and crushed glasses.** • **Each lab has a small pharmacy for first aid in case of an accident** **In each lab, the rules, conditions, and safety mechanism as well list of Risk, Safety precautions according to Merck Catalogue are hanging in the labs.**
Technology equipment (projector, smart board, software)	**The rooms are equipped with data show, Smart Board, WI-FI access.**

Items	Resources
Other equipment (depending on the nature of the specialty)	• **Appropriate Glasswares for carrying the requested experiments (conicals, beakers, measuring cyliders)** • **Appropriate fine chemicals and solvents (acetic acid, sodium chloride, some organic and inorganic inhibitors, hydrochloric acid, nitric acid, sulphuric acid)** • **Galvanic cell, metal electrodes, power supply, pH meter, Analytical balance (3 digits), Drying oven**

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of Students assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
The extent to which CLOs have been achieved	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Lab Performance	Students	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.
	Course Responsible	

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**COUNCIL OF DEPARTMENT OF CHEMISTRY**
REFERENCE NO.	**7 (NO. 2/3)**
DATE	**29/3/1446 - 2/10/2024**