Course Specification
(Bachelor)

Course Title:	Electrochemistry and Corrosion
Course Code:	CHM 1343
Program:	Bachelor of Science in Chemical Laboratories
Department:	Chemistry
College:	Science
Institution:	Imam Mohammed Ibn Saud Islamic University
Version:	1446-10-v1
Last Revision Date:	1446-10-v1

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: 3 (2, 3,0)					
3 (2 Lectures, 3 Lab, 0 Tutorials)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☐ Required		☒ Elective		
3. Level/year at which this course is offered: Level 5/ Third year					
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):					
Electroanalytical Methods - CHM 1238					
6. Co-requisites for this course (if any):					
None					
7. Course Main Objective(s): Industrial Catalysis, Reactions					

At the end of the course, Students should be able to:

- ✓ **Provide students with basics of electrochemical processes under standard and non-standard conditions.**
- ✓ **Familiarize students with the principles of some electrochemical techniques.**
- ✓ **Introduce corrosion and wear occurring to metals under different conditions.**
- ✓ **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	0	0
3	Hybrid • Traditional classroom • E-learning	0	0
4	Distance learning	0	0

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**	• Four hours weekly, containing lectures and laboratory activities • A Private study, including a Homework •	**Direct:** • exams, Quizzes • Homework Laboratory Reports • Participation
1.2	**To state Nernst equation for a galvanic cell potential due to change of redox system.**	**K1; K2**	• Two hours weekly, containing lectures • Group discussion	• Direct: • Oral tests • Homework and assignment marks, • Written exams
1.3	**To name laws of conductivity, resistivity and related phenomena.**	**K1**	• Lectures • Laboratory experiments.	**Direct:** • Participation, • Quizzes and MCQs, • laboratory reports
1.4	**To define corrosion and its impact upon metal integrity, and list**	**K2; K4**	• Lectures • Group discussions • Laboratory experiments.	**Direct:** • Participation, • Quizzes and MCQs, • laboratory reports

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
	methods of corrosion prevention			
2.0	**Skills**			
2.1	**To evaluate the equilibrium constant from experimental data, and contrast kinetic data with Mathematical equations.**	**S1; S3**	• Lectures • Laboratory experiments • Group discussion	**Direct:** • Solved problem marks • Short quizzes • Laboratory reports
2.2	**To analyze data and results through analytical thinking, with evaluation of the gained information.**	**S1; S2; S3**	• Brain storming • self-study	**Direct:** • Quizzes, • Lab reports, • Class questioning, • Exams (midterms and finals)
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.	**Direct:** • Quizzes, • Class questioning,
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, K4**	• Seminars • Group discussions • Lab experiment • Encourage students to use electronic mail and blackboard to submit works and assessments.	**Direct:** • Presentation marks • Oral tests and lab sheets • Assignments and homework • Laboratory performance • Laboratory reports and sheet
3.0	**Values, autonomy, and responsibility**			
3.1	**To appraise coordination and raise knowledge during various evaluations, initiatives, and mini**	**V2**	• Group discussions • Homework • Mini reports • Virtual labs and demonstrations	**Direct:** • Presentation marks • Oral tests and lab sheets • Assessments and homework

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
	reports to uphold scientific integrity.			• Laboratory reports and sheet
3.2	**Show personal values and attributes such as honesty, empathy and respect for others**	**V1, V2**	• Teamwork and class discussions	**Direct** • lab reports • Mini projects

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.	**Electrode 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.	**8**

5.	**Chemical Corrosion:** Electrochemical Corrosion, the Electrode Potential in Electrochemical Cells. Types of Electrochemical Corrosion, Protection Against Electrochemical Corrosion.	4
	Laboratories Topics	
1	Safety and Laboratory equipment's and measurements and reports	3
2	Electrolysis of Water	3
3	Electrochemical Studies on Different Galvanic Cells	3
4	Electrochemical Studies on Concentration Cells.	3
5	Electroplating.	3
6	Determination Of Cell Constant.	3
7	Determination of Equivalent Conductance of a Strong Electrolyte.	3
8	Dissociation Constant of Weak Acid.	3
9	Part1: Solubility product Ksp by conductivity method 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	3
12	Corrosion rate (corrosion current)	3
13	Potentiometric Titration of a Bromide-Iodide Mixture	3
14, 15	Revision and Lab. Reports overview	6
Total		**75**

D. Students Assessment Activities

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

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
			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.
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) 1. **Experimental Electrochemistry: A Laboratory Textbook**, R. Holze 1st Ed., (2009), Wiley-VCH. ISBN-13: 978-3527310982
Electronic Materials	• **Blackboard** • **www. Elesevier.com**
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 (conical flasks, beakers, measuring cylinders)** • **Appropriate fine chemicals and solvents (distilled Water ammonium nitrate)** • **Analytical balance (3 digits), Set gas laws with the glass jacket Data acquisition set for gas laws with glass jacket, PC, Windows® 95 or higher, calorimeter, thermometer, Filter papers , clamps, stands**

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.
Other		

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.	**3 (NO. 1/3)**
DATE	**5/3/1446- 8/09/2024**