



# Course Specifications

<b>Course Title:</b>	Electrochemistry
<b>Course Code:</b>	233CHEM-3
<b>Program:</b>	Bachelor of Science in Chemistry
<b>Department:</b>	Chemistry
<b>College:</b>	Science
<b>Institution:</b>	King Khalid University

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## A. Course Identification

<b>1. Credit hours:</b> 3
<b>2. Course type</b>
a. University <input type="checkbox"/> College <input type="checkbox"/> Department <input checked="" type="checkbox"/> Others <input type="checkbox"/>
b. Required <input checked="" type="checkbox"/> Elective <input type="checkbox"/>
<b>3. Level/year at which this course is offered:</b> 4 <sup>th</sup> level / 2 <sup>nd</sup> year
<b>4. Pre-requisites for this course (if any):</b> 232Chem-2
<b>5. Co-requisites for this course (if any):</b> None

### 6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	3	100%
2	Blended	0	0%
3	E-learning	0	0%
4	Correspondence	0	0%
5	Other	----	----

### 7. Actual Learning Hours (based on academic semester)

No	Activity	Learning Hours
<b>Contact Hours</b>		
1	Lecture	45
2	Laboratory/Studio	0
3	Tutorial	0
4	Others (specify)	0
	<b>Total</b>	45
<b>Other Learning Hours*</b>		
1	Study	20
2	Assignments	10
3	Library	5
4	Projects/Research Essays/Theses	5
5	Others (specify)	5
	<b>Total</b>	45

\* The length of time that a learner takes to complete learning activities that lead to achievement of course learning outcomes, such as study time, homework assignments, projects, preparing presentations, library times

## B. Course Objectives and Learning Outcomes

### 1. Course Description

The electrochemistry course introduces the student to the fundamentals of electrochemical reactions and the basic thermodynamics of redox reactions, with a focus on galvanic cells and electrolytic cells and their applications such as batteries, electroplating, electrolysis and mineral purification. This course also covers the basics of electronic and ion electrical conduction and electrical conduction applications.

## 2. Course Main Objective

This course aims to introduce students the basic knowledge and principle in electrochemistry: Redox reaction, electrochemical cells (galvanic and electrolytic cells), thermodynamic of Redox reactions, electrochemical applications (e.g. fuel cells, batteries, electrolysis, electrodeposition), and electrolytic conductance. The course will be divided into five sections that represent the key topic areas of electrochemistry fundamentals and applications. The overall goal of this class is to enable students to: acquire basic knowledge of electrode potentials & electrochemical cells; differentiate between electrochemical cells; acquire basic principles underlying electrochemical applications

## 3. Course Learning Outcomes

CLOs		Aligned PLOs
1	<b>Knowledge:</b>	
1.1	Understand knowledge of basic concepts and principles of electrochemistry	K1 and K2
1.2	Understand the nature of redox reactions from a thermodynamic point of view	K1 and K2
1.3	Memorize the basic principles underlying the electrochemical cells and their applications	K3
1.4	Understand the importance of electrical conductivity from a theoretical and practical standpoint	K1 and K2
2	<b>Skills :</b>	
2.1	Interpret and explain of the mechanism of redox reactions, with the possibility of weighing equations in different media	S4
2.2	Analyze and calculate of the reducing potential of different electrodes	S4
2.3	Design of galvanic cells with a predetermined voltage	S4
2.4	Predict the spontaneity of electrochemical reactions with the calculation of their free energy and general potential	S4
3	<b>Competence:</b>	
3.1	Effective communication between students and professor, and between students themselves	C2 and C4
3.2	Commitment to hand over duties and carry out activities on time	C2 and C4
3.3	Teamwork in small groups	C2 and C4

## C. Course Content

No	List of Topics	Contact Hours
1	Chapter One: Introduction Fundamentals of electrochemistry - definitions of oxidation and reduction process, oxidizing agent and reducing agent, concepts of redox reactions	3
2	Electrical conduction - types of electrochemical cells - drawing and coding of electrochemical cells - comparison between the reactions that generate and consume electrical energy	3

3	Chapter two: Reduction and oxidation reactions Calculate the numbers of oxidation and the nine rules to calculate the number of oxidation of any element either in ionic form, or within a compound - Distinguish between oxidation and reduction reactions and chemical reactions - Write electrochemical reactions by using half-equation method	3
4	Balancing the electrochemical equations using the ion-electron method, whether in an acidic or basic medium Balancing electrochemical equations by the method of preparing oxidation, whether in an acidic or basic medium	3
5	Chapter III: Galvanic Cells Galvanic cell genesis – Daniell’s cell - various examples of galvanic cells - representation of galvanic cells - encoding galvanic cells - expression of galvanic cells	3
6	Electrode potential - electrochemical cell voltage - reducing electrode potential - standard hydrogen electrode - unknown electrode voltage determination	3
7	Electrochemical series - method of building the electrochemical series - indications of electrode potentials in the electrochemical series	3
8	Method for calculating the general cell potential - the spontaneity of electrochemical reactions - the change in the free energy of the electrochemical reactions - prediction of the spontaneous reactions by the electrochemical series	3
9	Nernst equation - effect of electrolyte concentration on the general potential of the cell - thermodynamic equilibrium conditions - galvanic cell exhausting	3
10	Electrodes types - galvanic cells - primary cells - secondary cells - fuel cells - concentration cells	3
11	Chapter 4: Electrolytic cells The difference between the electrolytic cell and the galvanic cell - The mechanism of action of the electrolytic cell - Industrial applications of the electrolyte cell	3
12	Electroplating - Purification of metals from impurities - Extraction of elements from their natural sources - Preparation of compounds in industry using electrochemistry - Desalination of sea-water using electrochemistry	3
13	Faraday's First Law - Faraday's Second Law - Mathematical Applications of Faraday's Laws Chapter Five: Electrical Connection Electronic conductivity and ionic conduction - calculation of molar conductivity.	3
14	Houston’s bridge - specific conduction and resistivity Kohlrausch's law of independent ion migration - Arrhenius's theory of electrolytic decomposition - Collective properties of solutions - Debye Huckel’s theory	3
15	Midterm Exams	3
<b>Total</b>		<b>45</b>

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
<b>1.0</b>	<b>Knowledge</b>		
1.1	Understand knowledge of basic concepts and principles of electrochemistry	Lectures - interactive teaching sessions - recorded scientific presentations	Written exams - Oral quizzes - regular homework
1.2	Understand the nature of redox reactions from a thermodynamic point of view	Lectures - interactive teaching sessions - recorded scientific presentations	Written exams - Oral quizzes - regular homework
1.3	Memorize the basic principles underlying the electrochemical cells and their applications	Lectures - interactive teaching sessions - recorded scientific presentations	Written exams - Oral quizzes - regular homework
1.4	Understand the importance of electrical conductivity from a theoretical and practical standpoint	Lectures - interactive teaching sessions - recorded scientific presentations	Written exams - Oral quizzes - regular homework
<b>2.0</b>	<b>Skills</b>		
2.1	Interpret and explain the mechanism of redox reactions, with the possibility of weighing equations in different media	Lectures - interactive teaching sessions - recorded scientific presentations	Written exams - Oral quizzes - regular homework
2.2	Analyze and calculate of the reducing potential of different electrodes	Lectures - interactive problems solving sessions	Written exams - Oral quizzes - regular homework
2.3	Design of galvanic cells with a predetermined voltage	Lectures - interactive teaching sessions - recorded scientific presentations	Written exams - Oral quizzes - regular homework
2.4	Predict the spontaneity of electrochemical reactions with the calculation of their free energy and general potential	Lectures - interactive problem solving sessions	Written exams - Oral quizzes - regular homework
<b>3.0</b>	<b>Competence</b>		
3.1	Effective communication between students and professor, and between students themselves	Lectures - interactive teaching sessions	Scientific presentations - reports
3.2	Commitment to hand over duties and carry out activities on time	Lectures - interactive teaching sessions	Scientific presentations - reports
3.3	Teamwork in small groups	Lectures - interactive teaching sessions	Scientific presentations - reports

## 2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Electronic homework	5 and 9	10%
2	Oral quiz	7 and 11	5%
3	Presentation and reports	8 and 13	5%
4	Mid-term exam 1	6	15%
5	Mid-term exam 2	12	15%
6	Final exam	15	50%

\*Assessment task (i.e., written test, oral test, oral presentation, group project, essay, etc.)

& separated from theory lecture with independent lecturer

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :**

The faculty member supervising the course has 10 office hours distributed over the days of the week by two hours per day in order to guide students and support them and answer all questions related to the course and re-explain what is difficult to understand during the lectures.

## F. Learning Resources and Facilities

### 1. Learning Resources

<b>Required Textbooks</b>	Principles of Electrochemistry, Prof. Dr. Omar Al-Hazazi, Umm Al-Qura University, 2016
<b>Essential References Materials</b>	Electrochemistry, Prof. Dr. Magdy Wasel, Al-Azhar University, 2010
<b>Electronic Materials</b>	Scientific short demonstrations from You tube
<b>Other Learning Materials</b>	

### 2. Facilities Required

Item	Resources
<b>Accommodation</b> (Classrooms, laboratories, demonstration rooms/labs, etc.)	Air-conditioned rooms (45 seats)
<b>Technology Resources</b> (AV, data show, Smart Board, software, etc.)	Computer and projector
<b>Other Resources</b> (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	Wireless internet

## G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Course delivery (teaching methods and assessment methods)	Students	Questionnaire
	Departmental plan and curriculum committee; external reviewers.	Reports and workshops
	Program leader	Meeting
Course contents (update)	Departmental plan and curriculum committee; external reviewers.	Reports and workshops
Quality of learning resources	external reviewers.	Reports

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)

**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify))

**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

<b>Council / Committee</b>	Department counsel
<b>Reference No.</b>	1/22/142
<b>Date</b>	15-9-1442