



UNIVERSITI TEKNOLOGI MARA

CHM674: ADVANCED ELECTROCHEMISTRY

Course Name (English)	ADVANCED ELECTROCHEMISTRY APPROVED
Course Code	CHM674
MQF Credit	3
Course Description	The course deals with the types of electrochemical cells, electrochemical reactions on electrode surface, the use of electroanalytical techniques in the determination of dissolved analytes and the applications of electrochemistry in corrosion protection. The theories and concepts of electrochemical reactions on electrode surface will be discussed. Emphasis will be placed on principles and application of different electroanalytical methods including potentiometry, voltammetry and coulometry/electrogravimetry. The use of electrochemistry in corrosion prevention and control will also be introduced and discussed
Transferable Skills	Electrochemical Process Corrosion Protection Electroanalytical Techniques
Teaching Methodologies	Lectures, Lab Work
CLO	CLO1 Explain the concept of electrochemistry and electrochemical reactions on electrode surface CLO2 Describe the principles of electrochemistry in corrosion of metals and the applications of electrochemistry in corrosion prevention and in electroanalytical techniques CLO3 Conduct experiments involving electrochemical reactions, corrosion rate measurement and electroanalytical determination. CLO4 Describe the electrochemical experiments quantitatively and qualitatively in written report form.
Pre-Requisite Courses	No course recommendations
Topics	1. Introduction to Electrochemistry 1.1) 1.1 Balancing redox reactions (in alkaline and acidic solutions) 1.2) 1.2 Standard Electrode Potential/ Electrochemical Series 1.3) 1.3 Galvanic cell: Standard conditions, Non-standard conditions (Nernst Equation), Cell potential at equilibrium and equilibrium constant 1.4) 1.4 Electrolytic cell: Products at anode and cathode, Electrolysis of molten and aqueous salts, chlor-alkali process, electrolysis of water. 1.5) 1.5 The Variety of Electrode Reactions: Applications, Chemistry (Redox process at anode and cathode) 1.6) 1.6 Simple Electrode Reaction: electron transfer and mass transport (Diffusion, Convection and Migration - Nernst Diffusion Layer Model) 1.7) 1.7 Mechanisms of Electrochemical Reactions: Types of interaction, Adsorption of electroactive species at electrode, Electrocatalysis – H ₂ Evolution, Oxygen evolution, Overpotential 2. Corrosion Science 2.1) 2.1 Electrochemical corrosion of metals, types of corrosion (ie: uniform and localized – galvanic, concentration cell, pitting corrosion) 2.2) 2.2 Thermodynamic of corrosion: Application of Nernst equation, 2.3 Water stability diagram and Pourbaix diagram 2.3) 2.4 Kinetics of Corrosion: exchanged current density, corrosion potential (E _{corr}), corrosion current density (i _{corr}), Evan diagram, Corrosion rate measurements- weight loss of pure metals and alloys. 2.4) 2.5 Corrosion Prevention and Control – Electrochemical Protection (ie: Cathodic protection – impressed current and sacrificial anode and Anodic protection); Protective coatings (ie: Passive layer (Anodization/Passivation – active passive metal behaviour and metallic coatings) and Inhibitors (Anodic, Cathodic and Mixed types).

2.5) 2.6 Corrosion Protection Efficiency Measurements of Corrosion Protection Techniques (Linear Polarization Resistance (LPR))

3. Electroanalytical Techniques

3.1) 3.1 3-Electrode Potentiostat (Working electrode, Counter electrode, Reference electrode)

3.2) 3.2 Types and Principles of Electroanalytical Techniques

3.3) 3.3 Potentiometry: Principle and Applications (ie: Potentiometric Titrations)

3.4) 3.4 Voltammetry: Principle and Types of Voltammetry (ie: Cyclic Voltammetry – reversible, irreversible redox reactions; Dynamic Voltammetry – dropping mercury electrode (DME)- principle and uses)

3.5) 3.5 Coulometry and Electrogravimetry – principles and applications; constant current (galvanostatic) and constant potential (potentiostatic).

Assessment Breakdown	%
Continuous Assessment	100.00%

Details of Continuous Assessment	Assessment Type	Assessment Description	% of Total Mark	CLO
	Practical	Practical Skills	5%	CLO3
	Practical	Lab Reports	15%	CLO4
	Quiz	Quiz 1	5%	CLO1
	Quiz	Quiz 2	5%	CLO2
	Quiz	Quiz 3	5%	CLO2
	Quiz	Quiz 4	15%	CLO1
	Test	Test 1	15%	CLO1
	Test	Test 2	15%	CLO2
	Test	Test 3	20%	CLO2

Reading List	Recommended Text
	<ul style="list-style-type: none"> • D.A. Skoog, F.J. Holler and S.R. Crouch 2007, <i>Principles of Instrumental Analysis</i>, Tomson • D.A. Jones 1992, <i>Principles and Prevention of Corrosion</i>, Macmillan Publishing Co

Article/Paper List
This Course does not have any article/paper resources

Other References
<ul style="list-style-type: none"> • Website <i>Any Electrochemistry or Physical Chemistry articles</i> • Book D.B. Hibbert Macmillan Physical Science series 1993, <i>Introduction to Electrochemistry</i>, Macmillan Physical Science series • Book Derek Pletcher 1991, <i>A First Course To Electrode Process</i>, Electrosynthesis Co, Romsey, Hampshire • Book M. G. Fontana 1986, <i>Corrosion Engineering</i>, McGraw-Hill Book Company • Book V. S. Bagotzky 2006, <i>Fundamentals of Electrochemistry</i>, Wiley & Sons, New York