UNIVERSITI TEKNOLOGI MARA

CHM578: ELECTROCHEMISTRY

Course Name (English)	ELECTROCHEMISTRY APPROVED
Course Code	CHM578
MQF Credit	3
Course Description	The course deals with the principles of electrochemistry, electrochemical reactions on electrode surface, Corrosion of metals, corrosion rate measurements and the use of electrochemistry in corrosion protection will be discussed. The principles and applications of different electroanalytical methods will also be introduced and discussed
Transferable Skills	Learning: *Obtain the fundamental concepts of Electrochemistry, Electrochemical Reaction, Corrosion Protection, Electroanalytical Techniques. Exploration and Implementation Skills: *Instill skill to conduct laboratory experiment.*Analyse and report on experimental finding in a scientific manner.
Teaching Methodologies	Lectures, Lab Work
CLO	CLO1 To explain the basic concepts and theories of electrochemistry and its applications (corrosion science and electroanalytical techniques). CLO2 Display practical skills in experimental laboratory related to electrochemical reactions, corrosion of metals, corrosion rate measurements, electroanalysis of analytes using electrochemical methods. CLO3 Demostrate Communiction skills related to electrochemical reactions, corrosion of metals, corrosion rate measurements, electroanalysis of analytes.
Pre-Requisite Courses	No course recommendations

Topics
1. 1.0 Introduction to Electrochemistry 1.1) 1.1 Electrochemical Cells (Galvanic and Electrolytic), Cell Notation, Balancing electrochemical reactions. 1.2) 1.2 Thermodynamics of Cells, Work and Free Energy, Standard Electrode Potential / Electrochemical Series. 1.3) 1.3 Galvanic Cell ; Standard conditions, Non-standard conditions (Nernst Equation), Activity Coefficients, 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, Electrolytic Deposition, Faraday's First and Second Laws of Electrolysis. 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 – Nernst Diffusion Layer, Convection and Migration). 1.7) 1.7 Mechanisms of Electrochemical Reactions; Types of interaction, Adsorption of electroactive species at electrode, Electrocatalysis – H2 evolution, Overpotential
2. 2.0 Corrosion Science 2.1) 2.1 Electrochemical corrosion of metals, types of corrosion (ie; Uniform and localized – galvanic, concentration cell and pitting corrosion). 2.2) 2.2 Thermodynamics of corrosion; Application of Nernst equation. 2.3) 2.3 Water stability diagram and Pourbaix diagram. 2.4) 2.4 Kinetics of corrosion; exchanged current density, corrosion potential (Ecorr), corrosion current density (i corr), Evan diagram, Corrosion rate measurements – weight loss of pure metals and alloys. 2.5) 2.5 Corrosion Prevention and Control – Electrochemical protection methods (ie; Cathodic protection – impressed current and sacrificial anode; and Anodic protection), Protective coatings (ie; Passive layer – Anodization/Passivation, active passive metal behavior and metallic coatings) and Inhibitors (anodic, cathodic and mixed types). 2.6) 2.6 Corrosion Protection Efficiency Measurements of Corrosion Protection (ie; Tafel Extrapolation and

Linear Polarization Resistance Methods)

3. 3.0 Electroanalytical Techniques
3.1) 3.1 3-Electrode potentostat (working electrode, counter electrode and reference electrode).
3.2) 3.2 Types of Electroanalytical Techniques.
3.3) 3.3 Potentiometry ; Principle and Applications (ie; Potentiometric Titration).
3.4) 3.4 Voltammetry; Principle and and types of Voltammetry (ie; Cylic Voltammetry – reversible and irreversible redox reactions; Polarography – dropping mercury electrode DME).
3.5) 3.5 Coulometry and Electrogravimetry – principles and applications; constant current (galvanostatic) and constant potential (potentiostatic)

Assessment Breakdown	%
Continuous Assessment	60.00%
Final Assessment	40.00%

Details of Continuous Assessment

Assessment Type	Assessment Description	% of Total Mark	CLO
Practical	Practical Skills	5%	CLO2
Test	Test 1 - Introduction to Electrochemistry (Chapter 1A)	20%	CLO1
Test	Test 2 - Corrosion Science (Chapter 2A)	20%	CLO1
Written Report	Lab reports (3 experiments including Cyclic Voltammetry)	15%	CLO3

Reading List

Recommended Text

- **1. D.A. Skoog, F.J. Holler and S.R. Crouch 2007, *Principles of Instrumental Analysis*, Thomson**
- **D. A. Jones 1992, *Principles and Prevention of Corrosion*, Macmillan Publishing Co**
- **V. S. Bagotsky 2006, *Fundamentals of Electrochemistry*, Wiley & Sons**
- **D. B. Hibbert 1993, *Introduction to Electrochemistry*, Macmillan Physical Science Series**

Reference Book Resources

- **M. G. Fontana 1986, *Corrosion Engineering*, McGraw-Hill Book Co**
- **D. Pletcher 1991, *A First Course to Electrode Process*, Electrosynthesis Co**

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

Other References: This Course does not have any other resources