University of Management and Technology, Lahore
School of Science
Department of Chemistry
Certificate Course

Course Title:

Hands-on Applications of Potentiostat

By Dr. Mohsin Javed

Introduction:

This course will provide participants with an understanding of the principles and practical applications of Potentiostat in electrochemistry. Participants will learn about the various techniques used in potentiostat measurements, including cyclic voltammetry, chronoamperometry, and impedance spectroscopy. Through hands-on exercises and project-based learning, participants will gain experience with potentiostat and learn how to apply these techniques to solve real-world problems in electrochemistry.

Objectives:

- To provide an understanding of the principles and applications of potentiostat in electrochemistry.
- To familiarize with the various techniques used in potentiostat measurements, including cyclic voltammetry, chronoamperometry, and impedance spectroscopy.
- To develop skills for using potentiostat and interpreting electrochemical data.
- To provide an understanding of how to apply potentiostat techniques to solve real-world problems in electrochemistry research.

Learning Outcomes:

Upon completion of this course, participants will be able to:

- Understand the principles and practical applications of potentiostat in electrochemistry.
- Use potentiostat to perform various electrochemical measurements, including cyclic voltammetry, chronoamperometry, and impedance spectroscopy.
- Interpret electrochemical data and analyze experimental results using potentiostat techniques.
- Apply potentiostat techniques to solve real-world problems in electrochemistry research.

Duration:

04 Weeks (02 hours a day/ 02 days a week) Friday-Saturday 5 pm to 7 pm.

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Eligibility Criteria:

F. Sc. or equivalent

Course Outline:

Week	Sessions	Topics
1.	**1.**	**Fundamental Concepts** 1) Overview of potentiostat and its applications in electrochemistry, 2) Faradaic processes 2.1) Mass transport controlled reactions 2.1.1) Potential step experiments 2.1.2) Potential sweep experiments 3) Reactions controlled by the rate of electron transfer 1.1) Activated complex theory 4) The electrical double layer 5) Electrocapillary Effect
	2.	**Study of Electrode Reactions** 1. Cyclic Voltammetry 1.1) Data Interpretation 1.2) Reversible systems 1.3) Irreversible and Quasi-Reversible systems 1.4) Study of reaction mechanisms 1.5) Study of adsorption processes 1.6) **Spectroelectrochemistry** 1.4.1) Experimental arrangement 1.4.2) Principles and applications 1.4.3) Other spectroelectrochemical and Spectroscopic techniques
2.	**1.**	**Controlled potential techniques** 1) Chronoamperometry 2) Polarography 3) Pulse Voltammetry 3.1) Normal Pulse Voltammetry 3.2) Differential Pulse Voltammetry 3.3) Square Wave Voltammetry 3.4) Staircase Voltammetry 4) AC Voltammetry

	2.	1) Stripping Analysis 1.1) Anodic stripping voltammetry 1.2) Potentiometric stripping Analysis 1.3) Adsorptive stripping voltammetry and potentiometry 1.4) Cathodic stripping voltamettry 1.5) Applications **Flow Analysis** 1) Principles and cell design 2) Mass transport and current response 3) Detection modes 4) Examples of using potentiostat techniques to solve real-world problems in electrochemistry research
3.	**1.**	**Practical Consideration** 1) Electrochemical Cells 2) Solvents and supporting electrolytes 3) Oxygen removal 4) Working electrodes 4.1) Mercury electrodes 4.2) Solid electrodes 4.2.1) Rotating disk and ring disk electrodes 4.2.2) Carbon electrodes 4.2.2.1) Glassy carbon electrodes 4.2.2.2) Carbon paste electrodes 4.2.2.3) carbon fiber electrodes 4.2.3) Metal electrodes 5) Chemically modified electrodes 1.1) Self assembled monolayers 1.2) Sol-Gel encapsulation of reactive species 1.3) Electrocatalytic modified electrodes 1.4) Preconcentrating electrodes 1.5) Permselective coatings 1.6) Conducting polymers 6) Microelectrodes 2.1) Diffusion at microelectrodes 2.2) Configuration of microelectrodes 2.3) composite electrodes
	2.	1) Impedance Spectroscopy Principles and techniques of impedance spectroscopy

		2) Interpretation of impedance spectroscopy data Applications of impedance spectroscopy in electrochemistry research **Potentiometry** 1) Principles of potentiometric measurements 2) Ion selective electrodes 2.1) Glass electrodes 2.1.1) pH electrode 2.1.2) Glass electrodes for other cations 2.2) Liquid Membrane Electrodes 2.3) Solid state electrodes 2.4) Coated wire electrodes
4.	**1.**	**Electrochemical sensors** 1) Electrochemical Biosensors 2) Enzyme based electrodes 3) Gas sensors 4) Practical hand on experiment
	2.	Project-Based Learning

Evaluation Criteria:

Class Participation/Attendance:	10%
Quizzes:	20%
Assignments:	20%
Final/Project:	50%