IIT Mandi
Proposal for a New Course

Course number : **CY-524**
Course Name : **Basic and Applied Electrochemistry**
Credit : **3-0-0-3**
Distribution : ***L-T-P-C***
Intended for : M.Sc Chemistry, MTech, PhD

Prerequisite : Undergraduate level Physical Chemistry courses

Mutual Exclusion: (*courses with high similarity not allowed to credit by the students after or along with this course*)

---

1. Preamble:

This course is designed to provide students understanding of the fundamental of electrochemistry and to apply them. The course aims to introduce the concept of thermodynamics, reaction kinetics, transport phenomena in electrochemistry and how these fundamental principles of electrochemistry can be applied for analysis, electrochemical processes used in the industry, battery and fuel cell technologies.

2. Course Modules with quantitative lecture hours:

Topic 1: Interfacial Electrochemistry: (8 Hours)

Introduction and over view of electrochemical processes, Basic electrochemical thermodynamics, free energy, Nernst Equation, half reaction and electrochemical potentials, formal potentials, liquid junction potential, Faradic and non-Faradaic processes, electrode-electrolyte interface, electrical double layer, polarizable and non-polarizable interfaces, Pourbaix diagram, thermodynamics of batteries

Topic 2: Kinetics of Electrode reactions and Measurements:(8 Hours)

Essentials of electrode reactions, Butler Volmmer Model for electrode kinetics, one step-one electron process through potential energy diagram, standard rate constants, symmetry factor and transfer coefficients, Tafel slops, equilibrium condition and exchange current, mechanistic criteria; diffusion, activation phenomena, electron transfer theories, Marcus Theory, electrochemical transport process

Topic 3: Techniques for electrochemical methods: (14 Hours)

Current-potential relationship; methods of measurement of kinetic parameters; over potential, electrochemical Experiments and variables in electrochemical cells, reference electrode, three electrode cell, supporting electrolyte, steady state and potential step techniques; polarography; cyclic voltammetry; chronomethods; convective diffusion systems: rotating disc and ring disc electrodes; microelectrodes; impedance techniques - concepts and applications, Equivalent Circuit Dynamics, differential pulse voltammetry, square wave voltammetry, linear sweep voltammetry

Topic-4: Application of Electrochemistry: (10 Hours)

Pourbaix Diagram and relation to electrochemistry
Fundamentals of batteries: primary, secondary, reserve batteries; solid state and molten solvent- batteries; heterogeneous catalysis, sensor, fuel cells, photo-electrochemical solar cells and conversion of solar energy, Corrosion – fundamentals and applications.

Laboratory/practical/tutorial Modules: 0

3. Text books:

1. **J.O.M Bokris and A.K.N, Reddy Modern Electrochemistry, Volume 1 and 2, *Plenum Press N.Y. (1998)***
2. **A.J. Bard and L.R. Faulkner, Electrochemical Methods second edition, *John Wiley and Son (2001).***

4. References:

1. Scientists A. E.Gileadi,Electrode Kinetics for Chemists, Chemical Engineers and Material (VCH 1993)
2. Berry Rice and Ross, Physical Chemistry *published by OUP USA; 2 edition (11 May 2000)*

5. Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.		Course Code	Similarity Content	Approx. % of Content
1.	Electrochemical Systems for Energy Engineering	EN510	Electrochemical engineering fundamental, batteries basic	<10%
2.	Chemical thermodynamics and electrochemistry	CY514	Basic electrochemical thermodynamics and kinetics	<10%

6. Justification of new course proposal if cumulative similarity content is >30%:

l Sciences