Semester	AUG 2022
Open to semester	7,13,21
Course code	**CH4184/CH6334**
Course title	**Electrochemistry**
Credits	4 /4
Course Coordinator & participating faculty (if any)	Nirmalya Ballav
Nature of Course	Lectures and Tutorials
Pre-requisites	Physical Chemistry covered during first 2-years.
Objectives (goals, type of students for whom useful, outcome etc)	A student who has attended the course will be able to: Explain the nature of the electrochemical terms and concepts; Understand the nature of electrochemical reactions; Understand the kinetics of electrochemical reactions; and finally, Plan and perform electrochemical experiments, for examples, (i) cyclic voltammetry experiment; (ii) design an electrochemical cell; (iii) use the modern electrochemical techniques (chronoamperometry, chronopotentiometry, pulse voltammetry, square-wave voltammetry); (iv) perform an electrochemical impedance experiment and obtain the equivalent electric circuit for the studied electrochemical reaction. This course is useful for realizing the importance of electrochemistry in the emerging scenario of clean energy research and the sustainability.
Course contents (details of topics /sections with no. of lectures for each)	Ionics (12 h): Electrolytes in solution, Measurement of conductance, Theory of electrolytic dissociation, Ionic liquids, Ionic mobilities, Dielectric effect, Ionic strength, Dissociation of weak electrolytes, degree of dissociation, Debye Falkenhagen effect, Wien effect, Activities in more concentrated solutions, Polymer and Gel electrolytes and applications, Farday's laws, Transport number and its measurement, Hittorf’s theoretical method, Moving boundary method, Activity and activity coefficients of electrolytes, Debye-Huckel theory. Galvanic cells, Reversible cells, Reversible electrodes, and Thermodynamics of cell reactions. Basics of Electronics (2 h): Circuit elements, Capacitors, resistors, inductors, different types of AC circuits, simple

	capacitor circuit, capacitor resistor circuits, diodes, and p-n junction, Modern Electrochemistry (5 h): Electrification of interface, Origin of potential difference across the interface, Accumulation and depletion regions, Thermodynamics of electrified interface, Structure of electrified interface, Metal/solution & semiconductor solution interfaces, Band bending, Photo-electrochemistry. Electrodics (6 h): Electron transfer under an electric field, Butler-Volmer equation, Low potential case/High Potential case, Polarizable and nonpolarizable interface, the equilibrium condition Nernst's thermodynamic treatment, Symmetry factor and transfer coefficient, Electrode kinetics of semiconductor solution interface, Microelectrodes, lessening diffusion control by microelectrodes and reducing Ohmic errors. Electrochemical Techniques (8 h): Cyclic voltammetry, Impedance spectroscopy concepts and applications, Nyquist plot, Chrono methods, Scanning Electrochemical Microscopy, Mott-Schottky plot, Determination of flat band potentials and carrier concentration. Corrosion fundamentals and applications. Spectro-electrochemistry. Electrochemical Energy Conversion and Storage (8 h): Electrochemical energy systems. Batteries, fuel cells and electrochemical capacitors. Fundamentals and applied aspects. Primary and secondary batteries. Polymer electrolyte membrane fuel cells, solid oxide fuel cells etc. Double layer and pseudo- capacitors. Integration of electrochemical energy storage systems with other devices. Photo-electrochemical solar cells and conversion of solar energy, Photo-electrochemical water splitting. Electro-chemi-luminescence (ECL).
Evaluation /assessment	End-Sem Examination-35% Mid-Sem Examination-35% Others-30%
Suggested readings (with full list of authors, publisher, year, edn etc.)	(1) Modern Electrochemistry, Bockris and Reddy, Volumes 1-2A and 2B, Springer, 2006. (2) Electrochemical Methods: Fundamentals and Application,

	Allen J Bard, Wiley, 2nd Edition 2006