

For Approval (SENATE)

PH 821

**Paper Name: Electrochemical Storage for Clean Energy Systems**

**UNIT-I**

Fundamental Concepts in Energy Systems Electrochemical Cell, Faraday's laws, Electrode Potentials, Thermodynamics of electrochemical cells, Nernst Equation, Polarization losses in electrochemical cells, Electrode process and kinetics, Electrical double layer, Photoelectrochemical cell, thermoelectric effect.

**UNIT-II**

Nanomaterials for Energy Storage (Capacitor) Systems Capacitor, Electrochemical supercapacitors, EDLC, Pseudocapacitors, Hybrid capacitors, electrical double layer model, Principles and materials design, Nanostructured Carbon based materials, Redox capacitor NanoOxides, Conducting polymers based materials, flexible electrolytes, Typical applications.

**UNIT III**

Nanomaterials for Energy Storage (Batteries) Systems Issues and Challenges of functional Nanostructured Materials for electrochemical Energy Storage Systems, Primary and Secondary Batteries (Lithium ion Batteries), Cathode and anode materials, Nanostructured Carbon based materials, Nano-Oxides, Novel hybrid electrode materials, Factors affecting battery performance. Battery cell fabrication, Battery Analyser, Battery test equipment, Coin cell preparation.

**UNIT IV**

Nanomaterials for Energy Conversion Systems Issues and Challenges of functional Nanostructured Materials for electrochemical Energy, Conversion Systems, Fuel cell thermodynamics, Fuel Cells, Proton exchange membrane fuel cells (PEMFC), Direct methanol fuel cells (DMFC); Solid-oxide fuel cells (SOFC).

**UNIT V**

Cyclic Voltammetry Chrono potentiometry, Chrono amperometry, Galvanostatic Charge Discharge, Impedance Spectroscopy, Evaluation of active mass, surface area measurement - BET method, Internal resistance of cells - A.C. methods impedance method, Electrochemical AFM, Electrochemical STM, Electrochemical methods of corrosion rate measurements by Galvometric Tafel polarization, linear polarization and cyclic polarization.

**Textbooks:**

1. Electrochemical methods: Fundamentals and Applications, Allen J. Bard and Larry R. Faulkner, 2nd Edition John Wiley & Sons. Inc (2004)
2. D. Linden Ed., Handbook of Batteries, 2nd edition, McGraw-Hill, New York (1995) 7

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