Electrochemical Processes and Energy Systems

1.1 Course Number: CH451
1.2 Contact Hours: 3-0-0 Credits: 9
1.3 Semester-offered: 4th Year-Even
1.4 Prerequisite: NA
1.5 Syllabus Committee Members: Dr Milan Kumar, Dr Vivek Kumar

2. Objective:. The objective of course is to introduces the concept of electrochemical energy devices and their thermodynamics and kinetics. This course also devoted to teach students the details of flow batteries and fluid & mass transport in electrochemical systems.

3. Course Content:

Unit wise distribution of content and number of lectures

Unit	Topics	Sub-topic	Lectures
1	Introduction	Introduction to electrochemistry and electrochemical energy devices	3
2	Thermodynamics of Electrochemical Systems	Electrode and cell potentials, Junction potentials, Concentration cells, Electrochemical sensors	7
3	Electrode Kinetics and Interfacial Phenomena	Exchange current, Tafel equation, Butler-Volmer equation	5
4	Energy systems	Fuel cells and flow batteries. Working principles. Components and construction. Polarization.	4
5	Fluid flow and mass transport in electrochemical systems	Charge transport via diffusion, Migration and Convection. Ionic conductivity.	3
6	Electrochemical Impedance Spectroscopy (EIS) of energy systems	Resistive and Capacitive behavior of energy devices. Bode and Nyquist plots. Equivalent circuit.	5

7	Electrochemical Techniques	Linear scan Voltammetry, Chronoamperometry. Chronocoulometry, Cyclic voltammetry. Reversible, quasi-reversible and irreversible reactions. Porous electrode	13
		Total	**40**

4. Readings

4.1 Text Books:

1. Electrochemical Methods: Fundamentals and Applications, 2nd Edition, A.J. Bard and L.R. Faulkner.
2. Electrochemical Systems, 3rd Edition, John Newman and Karen E.Thomas-Alyea.
3. Fuel Cell Fundamentals, 3rd Edition, Ryan O'Hayre, Suk-Won Cha, Whitney G. Colella and Fritz B. Prinz.

4.2 Reference Books:

1. Lecture notes from MIT

5. Outcome of the Course:.At the end of this course, the student will be able to have knowledge of electrochemical systems and related concepts. The students will also have understanding of different electrochemical techniques.