Birla Institute of Technology & Science, Pilani
Hyderabad Campus

INSTRUCTION DIVISION
FIRST SEMESTER 2015-2016
Course Handout Part II

Date: 19-07-2015

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : CHEM F327
Course Title : **Electrochemistry: Fundamentals and Applications**
Instructor-in-Charge : Subhas Ghosal

Scope and Objective of the Course:
The course aims at covering topics in electrochemistry, with the broad classification of the entire subject into the domains viz., electrode processes, electron-transfer kinetics, mass transfer, and ECL. Starting with the fundamental principles and their applications, the ultimate purpose of this course is to provide a comprehensive survey involved in the different areas of electrochemistry before starting formal research in any of the electrochemical areas. Different electrochemical instruments will be covered to provide structural information about the electrode and surface microscopic methods. Finally, an out-line of photoelectrochemistry, electrochemiluminescence (ECL) and nanoplasmonics will be covered.

Textbooks:
1. A. J. Bard and L. R. Faulkner 'Electrochemical Methods: Fundamentals and Applications', 2nd Edition, (John Wiley & Sons, Inc., Copyright 2001).

Reference books
1. Bard, A. J., Ed., (from Vol. 19 with I. Rubinstein), "Electroanalytical Chemistry," Marcel Dekker, New York, 1966-1998.
2. Bockris, J. O'M., and B. E. Conway, et al., Eds., "Modern Aspects of Electrochemistry," Plenum, New York, 1954-1997.

Course Plan:

Lecture No.	Learning objectives	Topics to be covered	Chapter in the Text Book
1-4	Introduction and Overview of Electrode Processes	Electrochemical cells and reactions, working, reference, and counter electrode, electrolyte, overpotential, Faradaic and nonfaradaic Processes, capacitance, electrical double layer, and double-layer capacitance	Ch: 1, p.2-17

5-8	Electrochemical Cells	Primary and secondary cells, various electrochemical experiment, factors affecting electrode reaction, cell resistance, mass transfer, coupled reversible and irreversible reactions	Ch: 1, p.18-30, p.36-38
9-11	Potentials and Thermodynamics of Cells	Electrochemical thermodynamics, cell emf, formal potentials, electrochemical potential, liquid junction potentials, conductance, mobility, junction of two immiscible liquids, and selective electrodes	Ch: 2, p.44-53, p.60-68, p.73-79
12-15	Kinetics of Electrode Reactions	The Arrhenius equation and potential energy surfaces, transition state theory, electrode reactions, kinetics, Butler-Volmer model, implications of the Butler-Volmer model, and Tafel plots	Ch: 3, p.88-100, p.103
16-18	Multistep Mechanism	Electron transfer in rate-determining step, quasireversible and irreversible multistep process, charge transfer, and Marcus theory	Ch: 3, p.107-124
19-21	Mass Transfer by Migration & Diffusion	General mass transfer equation, migration, diffusion, and Fick's laws of diffusion	Ch: 4, p.137-139, p.146-150
22-25	Basic Potential Step Methods	Overview, detection, potential step under diffusion control, idea of ultramicroelectrodes (UME), chronoamperometric techniques, chronocoulometry, and applications of UME	Ch: 5, p.156-161, p.168-170, p.207- 217
26-28	Potential Sweep Methods	Introduction, reversible system, peak current and potential, irreversible system, quasireversible system, cyclic voltammetry (CV), and multicomponent system	Ch: 6, p.226-231, p.234-240, p.243 (partly self-study)
29-30	Concepts of Impedance	Various types, Faradaic impedance, kinetic parameters, electrochemical impedance, cyclic ac voltammetry, instrument for impedance	Ch: 10, p.368-370, 377, 398, 406
31-34	Instrumentation:	Potentiostats, Scanning tunneling microscopy (STM), scanning electrochemical microscopy (SECM), its applications	Ch: 15 & 16, p.640 (partly ss) p.659-676
35-39	Applications: Photoelectrochemistry and ECL	Electrogenerated chemiluminescence (ECL), kinds of experiments, analytical applications of ECL, photoelectrochemistry at semiconductors, semiconductor electrodes, photoeffects, electrochemical detection of photolytic and radiolytic products, AAO templates	Ch: 18, p.736-743, p.745-760, Class notes, self-study
40-42	Applications: Medicine	Applications of electrochemistry in medical technology and diagnostic devices, nanoplasmonic biosensors	Class notes, self-study

Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature of Component
Test1	1hr	20		Close Book
Test2	1hr	20		Close Book
Comprehensive Exam	3hr	40		20% Close Book 20% Open Book
Assignments and Tutorials	continuous	20		Open/close Book

Chamber Consultation Hour:

Notices: CMS, Chemistry Department notice board

Make-up Policy: Make up would be considered only for **regular students having genuine reasons.**

Subhas Ghosal

INSTRUCTOR-IN-CHARGE