SYLLABUS

1) Electrochemistry
2) Corrosion and its Control.
3) Modern methods of Chemical Analysis.
4) Chemical Fuels
5) Modern Materials.

MARKS

In-semester exams - 50% End-semester exams - 50%

20+30=50

In-sem exam = 20 M

1 quiz = 10 M

Quiz (class) = 20 M

REFERENCES

Engineering Chemistry by Jain M Jain
R.V Gadag
A Nityanand Shetty.

ENGINEERING CHEMISTRY - LAB (CHM-1061)

VOLUMETRIC ANALYSIS

1) Alkalimetric Titration
2) Total hardness of water
3) Estimation of percentage of Cu in brass.
4) Estimation of weight of Fe in haematite.
5) Estimation of percentage of Manganese dioxide in pyrolusite
6) Estimation of ammonia nitrogen in a fertilizer.

7) pK_a value of a weak acid by potentiometric titration
8) Conductometric acid-base titration.
9) Determination of conc of Cu using colorimeter
10) Determination of coefficient of viscosity of any liquid.
11) Chloride content of water } DEMONSTRATION
12) Analysis of lead pigment } ONLY

Electrochemistry

Electrochemistry is a branch of chemistry which deals with the properties and behaviour of electrolytes in solution and interconversion of chemical and electrical energies.

ELECTROCHEMICAL CELL

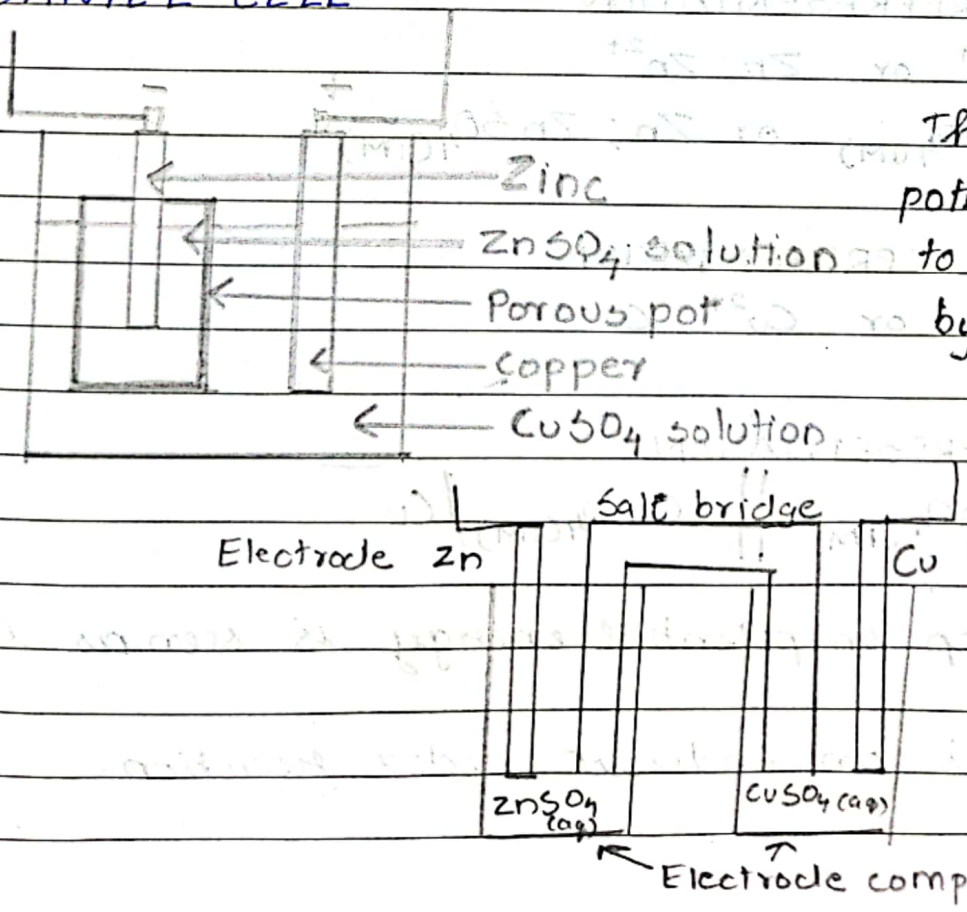
An electrochemical cell is a single arrangement of two electrodes in one or two electrolytes which converts chemical energy to electrical energy and vice versa.

Oxidation + Reduction in the same reaction → Redox Reaction.

eg: Zn in $CuSO_4$ solution

$$Zn + Cu^{2+} \longrightarrow Zn^{2+} + Cu \quad \Delta H = -ve \text{ (Exothermic)}$$

DANIEL CELL



The liquid junction potential can be reduced to about 1 to 2 mV by using a salt bridge.

Date: YOUVA

ANODE: $Zn \longrightarrow Zn^{2+} + 2e^-$ (Oxidation half)

CATHODE: $Cu^{2+} + 2e^- \longrightarrow Cu$ (Reduction half)

$\therefore Zn_{(s)} + Cu^{2+}_{(aq)} \longrightarrow Zn^{2+}_{(aq)} + Cu_{(s)}$

DIFFERENCES BETWEEN GALVANIC AND ELECTROLYTIC CELL.

GALVANIC CELL	ELECTROLYTIC CELL
• -ve anode, +ve cathode	• +ve anode, -ve cathode.
• Spontaneous electrochem reaction	• Non spontaneous reaction, it is forced
• Produces electrical energy	• Consumes electrical energy.
• Used as a portable energy source.	• Used for electroplating

REPRESENTATION OF GALVANIC CELL

- ANODE REPRESENTATION

  $Zn|Zn^{2+}$ or $Zn; Zn^{2+}$

  $Zn/ZnSO_{4(1M)}$ or $Zn; ZnSO_{4(1M)}$

- CATHODE REPRESENTATION

  Cu^{2+}/Cu or $Cu^{2+}; Cu$

- CELL REPRESENTATION

  $Zn/ZnSO_{4(1M)} \,||\, CuSO_{4(1M)}/Cu$

The drop in potential energy is seen as electrical energy.

This is an indirect redox reaction.

Date: YOUVA

EMF OF A CELL

Electromotive force (EMF) is the difference of potential which causes a current to flow from the electrode of higher potential to one of lower potential.

$$E_{cell} = E_{cathode} - E_{anode} \qquad (\pm E_J - \pi - I_r)$$

E_{cell} depends on:

- Temperature
- Concentration of electrolytes
- Nature of electrode

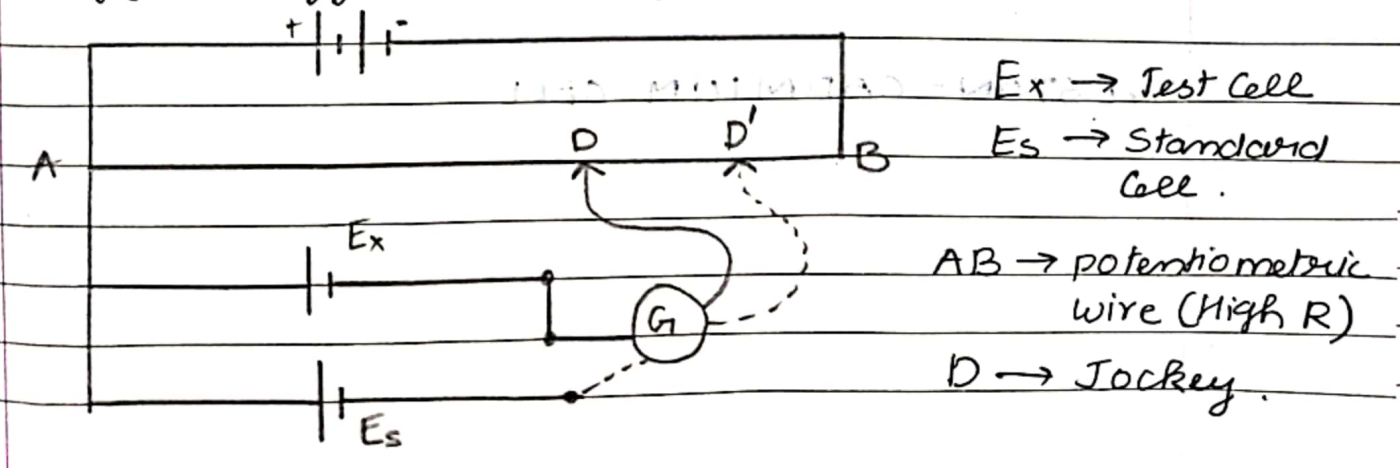
E_{cell} measured in standard conditions (298 K, 1 atm, unit conc) is called standard EMF or E°_{cell}

EMF cannot be accurately measured using a voltmeter.

- As some current is drawn from the cell that alters the concentration of the electrolytes and thereby causes a change in EMF
- As a part of the EMF is used to overcome the internal resistance of the cell.

MEASUREMENT OF EMF

Poggendorff's Compensation Method.



Find the null point by sliding the jockey on the potentiometric wire. This length AD is called balancing length.
Do the same for the standard cell. Its balancing length is AD'.

EMF ∝ balancing length.

$E_x \propto AD$

$E_S \propto AD'$

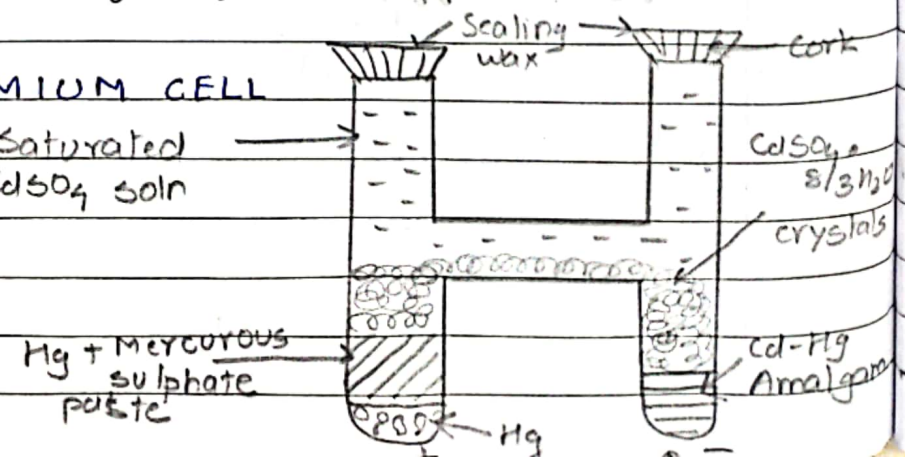
$$\frac{E_x}{E_S} = \frac{AD}{AD'} \qquad \boxed{E_x = \frac{AD}{AD'} \times E_S}$$

PRINCIPLE: The emf to be measured is opposed by the emf of another cell until the two emf's become equal and there is no net flow of current.

STANDARD CELL

- It is a cell capable of giving constant and reproducible emf.
- It has a negligible temperature coefficient of emf
- Eg: Weston-Cadmium Cell. The emf of the cell at 293K is 1.0183 V and 1.0180 V at 298 K
- Temp. coefficient of emf = -4×10^{-5} VK^{-1}

WESTON-CADMIUM CELL



ANODE: $Cd_{(s)} \longrightarrow Cd^{2+} + 2e^-$

CATHODE: $Hg_2^{2+} + 2e^- \longrightarrow 2Hg$.

Reaction: $Cd + Hg_2SO_4 \longrightarrow 2Hg + CdSO_4$

Cell representation:

$$Cd\text{-}Hg / Cd^{2+} ; Hg_2SO_4 / Hg$$