[This question paper contains 2 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 7250 **L**

Unique Paper Code : 2173520033

Name of the Paper : DSE : Bioelectrochemistry

Name of the Course : **B.SC. (HONS.) CHEMISTRY**

Semester : IV

Duration : 2 Hours Maximum Marks : 60

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **four** questions.
3. All questions carry equal marks.

1. (a) Distinguish between:
   i) Working Electrode and the Counter Electrode in a three-electrode setup.
   ii) Thermodynamic drivers of chemical and electrical signalling

   (b) What happens to the adsorption of anions and cations on a cell membrane as the potential moves across the PZC?

   (c) Why is the Electric Double Layer often modelled as a capacitor? (8,4,3)

2. (a) Draw the Equivalent Circuit Model for an electrochemical cell.

   (b) How can a sensor be designed to prevent interference from common electroactive noise when measuring neurotransmitters?

   (c) The physical significance of the transfer coefficient and the exchange current density, Explain. (5,5,5)

3. (a) Discuss the foreign body response when implanting microelectrodes into brain tissue.

   (b) Explain:
   i) Ideally Polarizable Electrode.
   ii) Potential of Zero Charge (5,10)

4. (a) Under what specific conditions does an electrode behave like a pure capacitor rather than a conductor?

   (b) Explain why some ions can adsorb onto an electrode surface even if the electrode carries a charge of the same sign as the ion.

   (c) Discuss the risk of protein denaturation upon adsorption to metal surfaces. (5,5,5)

P.T.O.

5. (a) Calculate the capacity of the Helmholtz layer per unit area for an interface of mercury in contact with a 0.01M NaF electrolyte. Model the value of the double layer thickness assuming a two-state water model, a positive charge on the electrode, and a local dielectric constant of six.

   (b) Derive the Butler-Volmer equation for a single-step, one-electron transfer process.

   (c) How do protein fouling and glial scarring affect the signal-to-noise ratio over chronic timescales? (5,5,5)

6. (a) Why is the surface area of the Counter Electrode typically designed to be much larger than that of the Working Electrode?

   (b) Discuss the industrial potential of using enzymes on electrodes for fine chemical synthesis.

   (c) What are the primary hurdles in scaling up these bio-electrochemical reactors compared to traditional heterogeneous catalysis? (5,5,5)