M.Sc. Examination, 2019

Semester-IV
Chemistry
Optional Course: CH-1021
(Physical Chemistry)

Time: Three Hours **Full Marks: 40**

Questions are of value as indicated in the margin.
Answer ***any four*** questions.

1. a) What are the differences between metal/solution (M/S) and semiconductor/solution (SC/S) interfaces? How the charge density varies inside a semiconductor? 3+2
   b) Starting from the Poisson-Boltzmann equation derive an expression of distance variation of potential. Why negative sign is taken for the potential variation with distance from the semiconductor surface? 4+1

2. Consider two chemical reactions which are coupled. Show that in order to attain steady state, σ must decrease with time. In this context justify the statement "steady state is fed with negative entropy". Also make a brief discussion on "Maxwell's Demon" in this context. 4+3+3

3. What do you mean by carrier mediated transport (CMT) in biological processes? Give an example. Show that in CMT, at any point inside the membrane the sum of concentrations of carrier and the complex is constant. Also show that inside the membrane, along the direction of flow, the chemical potential of the complex produced steadily decreases. 3+1+3+3

4. a) What is the physical meaning of the symmetry factor β? 2
   b) How the classical law of Nernst equation for the potential across an interface is obtained from equilibrium or zero current value of the potential difference? 4
   c) Write down the electronation reaction in corrosion process. 1
   d) How the corrosion inhibition method prevent corrosion? 3

5. a) Using the Fourier transform solve the Einstein's diffusion equation. The calculation implies that the Fourier transform of a Gaussian function is also a Gaussian function. Prove that their widths are not independent. Is it consistent with the Dirac delta function? 3+4+1
   b) Comment on the variation of mean square position of a free Brownian particle with time. 2

6. Write the Langevin equation of motion for a free Brownian particle. Mention the significance of each term. Based on this could you demand that the average of the random force is zero? Solving the Langevin equation calculate $\langle x^2 \rangle$ at both short and long times for a free Brownian particle. Why the result at short time does not matches with Einstein's result? 1+1+1+5+2

———