

2022
B.A./B.Sc.
Fifth Semester
 CORE – 12
CHEMISTRY
Course Code: CHC 5.21
 (Physical Chemistry – V)

Total Mark: 70
Time: 3 hours

Pass Mark: 28

Answer five questions, taking one from each unit.

UNIT-I

1. (a) How does the liquid junction potential relate to the transport number of ions t^+ and t^- . Explain with relevant mathematical expressions. 5
- (b) Explain why Walden rule is valid more accurately in larger ions than that of smaller ions. 3
- (c) What does it mean by relaxation effect? 3
- (d) Write a short essay on concentration cells without transference with a relevant example. 3

2. (a) Discuss the principle underlying conductometric titrations. How would you carry out conductometric titrations of a strong acid versus strong base. 2+4=6
- (b) Calculate the mean activity coefficient γ_{\pm} of NaCl at the molality of 0.01 m. 4
- (c) How does the solubility product help us to predict the precipitation reaction. 2
- (d) Explain the term ionic product of water. 2

UNIT-II

3. (a) What are redox electrodes? Explain with suitable examples. 4
- (b) Explain the cell reactions taking place in a calomel electrode in the electric field. 4

- (c) The EMF of the cell Cd, CdCl₂·2.5H₂O saturated || AgCl(s), Ag in which the cell reaction in

$$\text{Cd (s)} + 2\text{AgCl (s)} + \text{aq} \rightleftharpoons \text{CdCl}_2 \cdot 2.5\text{H}_2\text{O (s)} + 2\text{Ag (s)}$$
 in 0.6753 V at 25°C at 0.6915 V at 0°C. Calculate the free energy change and enthalpy of the cell reaction at 25°C. 4
- (d) Give an example each of the following: 1+1=2
- Metal-amalgam electrode
 - Metal-metal insoluble salt electrode
4. (a) What is Helmholtz Perrin model? Why is it also known as parallel plate condenser model? 3+2=5
- (b) Write a short essay on electro catalysis and its applications. 3
- (c) Write a short note on the following: 3×2=6
- Quinone-hydroquinone electrodes
 - Glass electrode
 - Hydrogen electrode

UNIT-III

5. (a) Write short notes on the following: 3×3=9
- Symmetric and anti-symmetric nature of BMO and a BMO
 - Need of approximation techniques
 - Paramagnetic nature of oxygen molecule
- (b) Outline the solution of the Schrödinger equation for H₂⁺ ion. Sketch the BMO and ABMO with respect to electron density on the bond axis. 5
6. (a) Construct a MO wave function for the bond between H and Cl in HCl assuming that the bond is formed from the 1s electron of H atom and 3p electron of Cl atom. 4
- (b) Explain the paramagnetic nature of oxygen along with its application in medical and war field. 4
- (c) Write a short essay on the need of approximation techniques in quantum mechanics. 4
- (d) Give a comparison of MO and VB theory. 2

UNIT-IV

7. (a) Give a statement of Frank quantum principle. Explain the principle for the electronic transition of a diatomic molecule. 1+4=5
(b) Write short notes on the following: 3+3=6
(i) Free electron model of polyenes
(ii) Larmor precision
(c) Using the free electron modal theory, estimate wave number of the lowest energy transition in the 1,3,5-hexatriene molecule. 3
8. (a) Explain the singlet and triplets states in electronic transition. 4
(b) Discuss the spin-spin interaction in NMR. 4
(c) Explain the hyperfine structure of methyl radical using ESR spectra. 4
(d) Calculate the ESR frequency of an unpaired electron in a magnetic field of 0.33 T given that for the free electron $g_e=2$ and $\mu_B=9.273\times 10^{-24}$ J/T. 2

UNIT-V

9. (a) Write short notes on the following with supporting formulae: 3×3=9
(i) Molar extension coefficient
(ii) Photochemical rate law
(iii) Integrated absorption coefficient
(b) Explain why the quenching of florescence occurs. 3
(c) Explain the term electromagnetic radiation. 2
10. (a) Explain the reasons for low and high quantum yield in photochemical reaction. 4
(b) Derive the photochemical rate law in terms of Lambert-Beer law. 5
(c) What does it mean by bioluminescent reaction? Explain with suitable example. 3
(d) What is meant by photosensitization reaction? 2
-