2023

B.A./B.Sc.

Fourth Semester

CORE – 10

CHEMISTRY

Course Code: CHC 4.31

(Physical Chemistry - IV)

Total Mark: 70 *Pass Mark: 28*

Time: 3 hours

Answer five questions taking one from each unit.

UNIT–I

1. (a) Give the postulates of Arrhenius theory of ionization. Discuss the limitations of Arrhenius' theory. 4+3=7
   (b) What is meant by molar conductivity? Establish its relationship with specific conductivity. 3
   (c) The conductivity of a solution containing 1 gram of anhydrous $BaCl_2$ in 200 cm^{-1}. What are the molar conductivity and equivalent conductivity of the solution? (At. wt. of Ba = 137 and Cl =35.5) 4

2. (a) Define transport number of an ion. Describe Hittorf's method for the determination of transport number. 1+6=7
   (b) What is meant by transference number? How does it relate with ionic mobility? 3
   (c) During the electrolysis of a solution of potassium chloride between platinum electrode, 0.0137 g of the chloride was lost from anodic compartment and 0.0857 g of silver was deposited in a silver coulometer connected in series with the cell. Determine the transport number of K^+ and Cl^- ions. 4

UNIT–II

3. (a) What is meant by EMF of a cell? How is it measured? 1+5=6
   (b) Describe the application of electrolysis in metallurgy and industry. 4

(c) Calculate the standard EMF of a cell which involves the following cell reaction. $Zn + 2Ag^{+} \rightarrow Zn^{2+} + 2Ag$

Given that $E^{0}_{Zn,Zn^{2+}} = 0.76$ volt and $E^{0}_{Ag,Ag^{+}} = -0.80$ volt 4

4. (a) Discuss the theory of an apparatus used for polarography. 6

(b) Derive Nernst equation for the calculation for the potential of hydrogen-electrode. 4

(c) Calculate the electrode potential (reduction potential) of each of the following single electrode at 25° C. 4

(i) $Sn / Sn^{++} (a = 0.01)\, E^{0}_{Sn^{++},Sn} = 0.14V$

(ii) $Ag / AgCl(s), Cl^{-} (a = 0.0001)\, E^{0}_{AgCl,Cl^{-}} = 0.22V$

UNIT–III

5. (a) Discuss the ionization of a weak base and establish the relation between the degree of ionization with dilution. 5

(b) Explain ionic product of water and pH of a solution. 4

(c) Establish the relation between degree of hydrolysis *h* and pH for a salt of strong acid and weak base. 5

6. (a) Discuss the ionization of a weak acid and establish the relation between the degree of ionization with dilution. 5

(b) Derive the dissociation constant of monoprotic and diprotic acid. 4

(c) Establish the relation between degree of hydrolysis *h* and 'pH' for a salt of weak acid and strong base. 5

UNIT–IV

7. (a) Derive the expression of the energies of rotational levels for diatomic molecules taking it as a rigid rotator. 6

(b) State and explain the selection rules for rotational and vibrational spectra. 4

(c) Describe Morse potential energy curve for higher amplitude of vibration. 4

8. (a) Give the expression of vibrational-rotational spectra for a diatomic molecules taking it as a anharmonic oscillator. 5

(b) "Pure rotational spectra are also known as microwave spectra." Why? Explain one application of microwave spectroscopy. 2+3=5

(c) Write a note on "concept of group frequencies." 4

UNIT–V

9. (a) Discuss how to determine the dielectric constant of different materials. 6

(b) Define dipole moment. Explain the measurement of dipole moment by refractive method. 1+3=4

(c) Write a note on the following: 2×2=4

(i) Bond moment

(ii) Electrostatic of dielectric

10. (a) What is magnetic susceptibility? Describe the method of measurement of magnetic susceptibility. 1+5=6

(b) The bond angle in H_2O is 104.5° and the dipole moment is 1.85 D. Calculate the bond moment for the O–H bond.
Given: cos 52.25° = 0.6129. 2

(c) Write short notes on the following: 2×3=6

(i) Diamagnetism

(ii) Paramagnetism

(iii) Ferromagnetism