

**April 2025**  
**B.A./B.Sc.**  
**Fourth Semester**  
**GENERIC ELECTIVE – 4**  
**CHEMISTRY**  
*Course Code: CHG 4.11*  
(Physical Chemistry for Biosciences)

Total Mark: 70

Pass Mark: 28

Time: 3 hours

Answer five questions, taking one from each unit.

**UNIT-I**

1. (a) What is thermochemical equation? Explain. 2  
(b) Explain the differential enthalpies of solution. 4  
(c) Calculate the standard enthalpy of formation of naphthaline (C<sub>10</sub>H<sub>8</sub>) when the standard enthalpy of combustion of naphthaline is –5153 kJ and the standard enthalpies of formation of CO<sub>2</sub> and H<sub>2</sub>O are –393.5 and –285.8 kJ mol<sup>-1</sup> respectively. 5  
(d) Give the two thermochemical laws. 3
2. (a) Calculate the heat of formation of KOH from the following data. 4  
(i)  $K(s) + H_2O + aq \rightarrow KOH + \frac{1}{2}H_2$   $\Delta H = -48.0 \text{ kcal}$   
(ii)  $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$   $\Delta H = -68.5 \text{ kcal}$   
(iii)  $KOH(s) + aq \rightarrow KOH(aq)$   $\Delta H = -14.0 \text{ kcal}$   
(b) Explain the third law of thermodynamics. 3  
(c) Derive an expression for variation of enthalpy of a reaction with temperature. 5  
(d) What is bond dissociation energy? Explain. 2

**UNIT-II**

3. (a) Explain the effect of change concentration based on Le Chatelier's principle. 3  
(b) Derive the relationship between K<sub>p</sub>, K<sub>c</sub>, and K<sub>x</sub> for reaction involving ideal gas. 5

- (c) Write a note on the distinction between  $\Delta G$  and  $\Delta G^\circ$  giving their mathematical expression. 4
- (d) State the law of chemical equilibrium. 2
4. (a) Define order of reaction and derive the rate constant expression for first order reaction. 1+4=5
- (b) Discuss the half-life method for the determination of order of reaction. 4
- (c) What is activation energy? Derive the integrated form of Arrhenius equation. 1+4=5

### UNIT-III

5. (a) What are strong and weak electrolytes? Give specific examples. 4
- (b) Explain the ionization constant of a weak acid. 3
- (c) Write a note each on the following: 2×2=4
- (i) Ionic product of water
- (ii) Common ion effect
- (d) A monobasic acid has dissociation constant equal to  $1.8 \times 10^{-5}$  at  $25^\circ\text{C}$ . Calculate its degree of dissociation at a concentration of 0.02 M at the same temperature. What will be the hydrogen concentration furnished by it? 3
6. (a) What is solubility product? Explain the application of solubility product principle. 5
- (b) Establish the relation between hydrolysis constant ( $K_h$ ), ionization constant ( $K_a$ ) and ionic product of water ( $K_w$ ) and express the degree of hydrolysis (h) for the salt of weak acid and strong bases. 5
- (c) Ionization constant of acetic acid and ionic product of water at  $25^\circ\text{C}$  are  $1.75 \times 10^{-5}$  and  $1 \times 10^{-14}$  respectively. Calculate the hydrolysis constant of sodium acetate and its degree of hydrolysis in 0.1 molar solution at  $25^\circ\text{C}$ . 4

### UNIT-IV

7. (a) Write a note each on the following: 3×2=6
- (i) Degrees of freedom
- (ii) Eutectic point

- (iii) Nernst distribution law
- (b) Discuss the phase rule for a phase equilibria system. 3
- (c) Draw and discuss the phase diagram of lead-silver system. 5
8. (a) What are azeotropes? Explain the azeotropes taking the examples of water-ethanol system. 1+5=6
- (b) Calculate the number of phase and components in each of the following system: 1½×2=3
- (i) Dissociation of  $\text{PCl}_5$
- (ii) Dissociation of  $\text{NH}_4\text{Cl}$  in a closed vessel
- (c) What are ideal solutions? Explain the Raoult's law which governs the ideal solutions. 5

### UNIT-V

9. (a) What is equivalent conductance? How does it vary with dilution? 4
- (b) What are the postulates of Arrhenius theory of an electrolytic dissociation? Give its limitations. 5
- (c) The resistance of 0.01 (N) NaCl solution at 298 K is 200 ohms. The cell constant of the conductivity is unity. Calculate the equivalent conductance. 3
- (d) What is migration of ions? 2
10. (a) Explain the Stark-Einstein law of photochemical equivalence. 4
- (b) Calculate the energy of one photon of light with wavelength 2450 Å. Will it be able to dissociate a bond in a diatomic molecule which absorbed this photon and has a bond energy equal to 95 kcal per mole. 3
- (c) What do you understand by fluorescence and phosphorescence? Give example. 3
- (d) Discuss the quantum yield in photochemical reaction. 4