2023
B.A./B.Sc.
Second Semester
CORE – 4
CHEMISTRY
Course Code: CHC 2.21
(Physical Chemistry - II)

Total Mark: 70 *Pass Mark: 28*
Time: 3 hours

Answer five *questions, taking* one *from each unit.*

UNIT–I

1. (a) State and give the mathematical expression for the first law of thermodynamics. 4
   (b) What do you understand by heat capacities of a system? Explain the two type of heat capacity of a system. 1+3=4
   (c) Calculate the pressure-volume and work performed by the system during reversible isothermal expansion of two moles of ideal gas from 2 litres to 10 litres at 20°C. 3
   (d) Write short notes on the following: 1½×2=3
      (i) Internal Energy
      (ii) Enthalpy

2. (a) What is spontaneous process? Give the criteria for spontaneity of a process. 1+3=4
   (b) Derive the expression for maximum work obtainable from isothermal reversible process. 5
   (c) What do you understand by statistical interpretation of entropy? 2
   (d) Calculate the ΔE and ΔH on heating 64.0 g of oxygen from 0°C to 100°C when the values of C_v and C_p are 5.0 and 7.0 cal/mol respectively. 3

UNIT–II

3. (a) What is residual entropy? Explain. 3

(b) What is heat of reaction? Derive the Kirchoff's equation. 1+4=5

(c) The standard heat of formation of C_2H_5OH (l), CO_2 (g) and H_2O (l) are: –277.0, –393.5 and 285.5 kJ/mol respectively. Calculate the standard heat change for the reaction. 3

(d) Write a note on endothermic and exothermic reaction. 3

4. (a) Explain heat of combustion with examples. What are the applications of heat of combustion? 2+3=5

(b) Define bond energy. Explain the parameters in which the bond energy depends. 1+3=4

(c) Given that energies for H–H, O=O and O–H are 104, 118, and 111 kcal/mol respectively. Calculate the heat of reaction. 4

(d) Give the statement of third law of thermodynamic. 1

UNIT–III

5. (a) What is Helmholtz and Gibbs free energy? Explain their significance. 2+4=6

(b) Derive the expression for variation of Gibbs free energy change with temperature and pressure. 5

(c) Write a note on Joule-Thomson coefficient. 3

6. (a) What is inversion temperature? Explain how Joule-Thomson coefficient is related to other thermodynamic parameters? 1+5=6

(b) Derive the expression for Gibbs-Helmholtz equation. 3

(c) Write a note on chemical potential of ideal mixtures. 5

UNIT–IV

7. (a) What are the criteria of thermodynamic equilibrium? 3

(b) Thermodynamically, derive the expression for equilibrium constant. 6

(c) State Le Chatelier principle. Explain the effect of temperature and pressure on the state of equilibrium with examples. 1+4=5

8. (a) What do you meant by degree of advancement of a chemical reaction? 3

(b) Derive the thermodynamic relation between Gibbs free energy of reaction and reaction quotient. 6

(c) Explain and derive how K_p, K_c and K_x are related to one another. 5

UNIT–V

9. (a) What is meant by colligative properties? Show how molar mass of a non-volatile solute can be determine from lowering of vapour pressure. 1+4=5

   (b) 0.5 g of non-volatile solute of molar mass 60.0 g mol^{-1} is dissolved in 100 g of ethyl acetate at 20°C. What would be the vapour pressure of this solution at 20°C? The vapour pressure of ethyl acetate at 20°C is 72.8 torr. 4

   (c) Considering two pure components say *A* and *B* forming ideal solution. Calculate the free energy change on mixing. 5

10. (a) Define chemical potential. Determine the elevation of boiling of a liquid (T_b) in terms of chemical potential when a non-volatile solute is added to a solvent. 1+6=7

    (b) How many gram of sugar (mol. wt. 342) may be dissolved in 500 g of water so as to have an elevation in boiling point of 0.13°C? (Given K_b of water = 0.52 $K.Kg^{-1}mol^{-1}$). 4

    (c) State and explain Raoult's law. 3