**NKT/KS/17/5173**

**Bachelor of Science B.Sc. Semester—V (C.B.S.) Examination**

**CH-502 : PHYSICAL CHEMISTRY**

**(Chemistry)**

**Paper—2**

Time : Three Hours] [Maximum Marks : 50

**N.B. :—** (1) All **FIVE** questions are compulsory and carry equal marks.

(2) Draw diagrams wherever necessary.

1. (A) Explain how classical mechanics fails when applied to :

(i) Photoelectric effect and

(ii) Heat capacity of solids. 5

(B) Derive Schrodinger wave equation by considering wave as a vibration of stretched string. 5

**OR**

(C) State and explain Heisenberg's uncertainty principle. 2½

(D) What are normalized and orthogonal wave functions ? 2½

(E) State postulates of quantum mechanics. 2½

(F) Calculate lowest energy and spacing between first two energy levels for an electron when placed in a box of length 1A°. 2½

2. (A) What are probability distribution curves ? Draw and discuss radial probability distribution curves for 3S and 3P orbitals. 5

(B) What are the conditions for the formation of molecular orbitals from atomic orbitals ? Discuss the physical picture of bonding and antibonding wave functions. 5

**OR**

(C) Explain azimuthal and magnetic quantum numbers. 2½

(D) Write Schrodinger wave equation for hydrogen like particles in terms of Cartesian co-ordinates. 2½

(E) Discuss graphically the variation of electron probability density for bonding molecular orbitals along the internuclear axis. 2½

(F) Explain valence bond theory for $H_2$ molecule. 2½

3. (A) Derive thermodynamically the relation, $\Delta T_b = K_b \times m$ (m = molality of the solution). 5

(B) Define :

(i) Magnetic permeability and

(ii) Molar magnetic susceptibility.

Describe Gouy's method for the determination of magnetic susceptibility. 5

**OR**

(C) The vapour pressure of a 5% aqueous solution of non-volatile organic substance at 373 K is 745 mm. Calculate the molecular mass of solute. 2½

(D) Discuss Berkeley- Hartley method for determination of osmotic pressure. 2½

(E) What is van't Hoff factor ? How is it used for the determination of degree of association of a solute in the solution ? 2½

(F) How magnetic susceptibility of a substance can be used to decide the structure of co-ordination compounds ? 2½

4. (A) State Grotthus-Draper law and Stark-Einstein's law of photochemical equivalence.

Calculate the energy of one photon of light of wavelength 2450 A°. Will it be able to dissociate a bond in diatomic molecule which absorbs this photon and has a bond energy equal to 95 Kcal $mol^{-1}$ ($h = 6.626 \times 10^{-34}$ JS $mol^{-1}$, $C = 3 \times 10^8$ $ms^{-1}$ and $N = 6.023 \times 10^{23}$ $mol^{-1}$). 5

(B) Define quantum yield of photochemical reactions. How can it be experimentally determined ? What are the reasons for high quantum yield of photochemical reactions ? 5

**OR**

(C) Explain Rayleigh's lines, Stokes' lines and anti-Stokes' lines in Raman spectra. 2½

(D) What are the advantages of Raman spectroscopy over infrared spectroscopy ? 2½

(E) Explain the phenomenon of radiative and non-radiative transitions using Jablonski diagram. 2½

(F) Write a short note on photosensitization. 2½

5. Attempt any **TEN** questions of the following :

(i) Define perfect blackbody.

(ii) State de-Broglie's hypothesis.

(iii) What is an operator ?

(iv) Write the expression for the energy for hydrogen like particles.

(v) What is an orbital ?

(vi) Draw potential energy curve for $H_2^+$ ion.

(vii) State Raoult's law.

(viii) Define cryoscopic constant.

(ix) Calculate the magnetic moment of a molecule having four unpaired electrons.

(x) State Beer's law.

(xi) What do you mean by singlet ground state ?

(xii) What is selection rule for pure rotational Raman spectra ? 1×10=10