CHEMISTRY Paper–XIX

(Physical Chemistry–A)

Time Allowed : Three Hours **Maximum Marks : 22**

Note : (i) Attempt **one** question from each Unit. Question No. 9 is compulsory.

(ii) Use of Logarithm tables or Calculator (non-programmable) is allowed.

UNIT – I

1. (a) What is the concept of particle in one-dimensional box ? What is the Schrodinger wave equation for such a case ? How can this equation be solved for ψ and E ? 2

   (b) Write the expression for the angular and the radial wave function, what do different symbols signify ? 2

2. (a) What are the postulates of quantum mechanics ? 2

   (b) Find the commutator of the operators for momentum and position, the two conjugate properties of Heisenberg's uncertainty principle. 2

UNIT – II

3. (a) What do you understand by Linear Combination of Atomic Orbitals (LCAO). How can it be applied to H_2^+ ion to calculate its energy? 2

   (b) Derive the values of the coefficients of atomic orbitals in the **three** sp^2 hybrid orbitals. 2

4. (a) Using LCAO approximation, write down the complete wave function for a heteronuclear diatomic molecule AB, assuming that it has 90% covalent character and 10% ionic character. 2

   (b) Represent diagrammatically the formation of bonding and antibonding molecular orbitals formed by the combination of $2s$ with $2s$ and $2p$ with $2p$ orbitals. How are they designated ? 2

UNIT – III

5. (a) What are photochemical reactions ? List the main points of difference between a photochemical reaction and thermochemical reaction. 2

   (b) State and explain first and second laws of photochemistry. 2

6. (a) Draw Jablonski diagram depicting various processes occurring in the excited state. 2

   (b) What is the energy in kcals of one mole of photons of wavelength 2573 Å ? 2

UNIT – IV

7. (a) Write short notes on 'Fluorescence' and 'Phosphorescence'. What is the difference between them ? 2

   (b) A certain system absorbs 3.0×10^{16} quanta of light per second. On irradiation for 20 mintues, 0.002 mole of the reactant was found to have reacted. Calculate the quantum efficiency of the process. 2

8. (a) On the basis of mechanism, how can you justify that quantum yield of photolysis of HI is 2 ? 2

   (b) Explain the term 'Photosensitization' with at least two suitable examples. 2

(Compulsory Question)

9. (i) How do spectral distribution curves of black body radiation prove Stefan-Boltzmann's law ?

   (ii) How is the variation method used to obtain the correct wave function ?

   (iii) What do you understand by gerade and ungerade molecular orbitals ?

   (iv) What is physical significance of extinction coefficient or absorptivity ?

   (v) Give the photolysis of ammonia.

   (vi) What are photoinhibitors ? How do they work ? $6 \times 1 = 6$