PHYSICAL CHEMISTRY

(Common with B.Sc. Biotechnology)
Paper-III
Semester-V

Time Allowed : 3 Hours] [Maximum Marks : 26

Note : The candidates are required to attempt two questions each from Section A and B carrying 4 marks each and the entire Section C consisting of 5 short answer type questions carrying 2 marks each.

SECTION-A

1. Explain, how classical mechanics fails when applied to the following :
   (a) photoelectric effect
   (b) heat capacity of solids. 4
2. (a) What do you mean by Sinusoidal wave equation? 2
   (b) Describe the concept of particle in one dimensional box. 2
3. (a) Write the expression for angular wave function. What do different symbols signify? 2
   (b) What are Spherical harmonics? Write expression for them when $l = 0$, $m = 0$. 2
4. What are quantum numbers? How do three quantum numbers follow from the solution of Schrodinger wave equation? What are the postulates of Quantum mechanics based on the postulates of Quantum mechanics? Derive Schrodinger wave equation. 4

SECTION-B

5. (a) What are the basic components of Spectrometer? 2
   (b) Discuss briefly Born-Oppenheimer approximation. 2
6. (a) Considering a diatomic molecule as rigid rotator, explain the type of rotational spectra obtained after deriving the expressions required. 2
   (b) What is the effect of Isotopic substitution on Rotational spectra? 2
7. (a) Calculate the force constant 'k' for N_2 molecule, given that the fundamental vibrational 'v' is 2358 cm^{-1}. 2
   (b) Discuss the selection rules for the vibrational transitions in a diatomic molecule. taking it as a simple Harmonic oscillator. 2
8. (a) How are infrared spectra helpful in the identification of Organic compound? 2
   (b) Discuss the energy levels of a simple harmonic Oscillator and draw the potential energy curve for it. 2

SECTION-C

9. (a) Derive Planck's radiation law. How can it be verified experimentally?
   (b) Using the concept of quantum mechanics, describe the shape of 's' and 'p' orbitals.
   (c) Write a short note on Electromagnetic spectrum.
   (d) Explain the relative intensities of the lines obtained in a pure rotational spectrum of diatomic molecules.
   (e) Explain, why a diatomic molecule should be considered as an hormonic oscillator.

$2 \times 5 = 10$