PHYSICAL CHEMISTRY–III

**(Common with B.Sc. & B.Sc. Biotechnology,
Industrial Microbiolgy)
Semester-V**

Time Allowed : 3 Hours]
[Maximum Marks : 35

Note : The candidates are required to attempt *two* questions each from Section A and B carrying 7 marks each and the entire Section C consisting of 7 short answer type questions carrying 1 marks each. Attempt *five* questions in all.

Section - A

1. (a) Derive an expression for Planks's Radiation Law. 4
   (b) What are Normalized, Orthogonal and Orthonormal function? 3
2. (a) Discuss the Postulates of Quantum Mechanics. 4
   (b) Differentiate between Classical Mechanics and Quantum Mechanics. 3
3. (a) Derive an expression for wave function 'ψ' and energy 'E' for a particle in one-dimensional

box. $\qquad$ 4

(b) Calculate ground state energy of an electron confined to move in a one-dimensional box of length 1 Å. 3

4. (a) Discuss the concept of degeneracy. Calculate degeneracy for $n_x = 1$, $n_y = 2$, $n_y = 3$. 4
   (b) Derive an expression for Schrodinger wave equation from the wave equation. 3

Section - B

5. (a) Derive an expression for wave number of the rotational lines in a pure rotational spectrum of diatomic molecule. 4
   (b) What is the effect of Isotopic subsitution on the rotational spectrum ? 3

6. (a) Define and discuss degrees of freedom of a molecule. 4.
   (b) Draw vibrational degrees of freedom for H_2O and CO_2 molecules. 3

7. (a) The rotational spectra of HCl consists of equally spaced lines separated by 10.41 cm^{-1}. Calculate moment of inertia and band length. 4
   (b) What are fundamental transitions and overtone transitions ? 3

8. (a) What are the factors which affect the width and intensities of spectral lines ? 4
   (b) Which of the following molecules will show rotational spectra and why ? H_2O, NO, H_2, HCl, O_2, C_6H_6. 3

Section - C

9. (a) Evaluate $\left[\hat{x}, \dfrac{\hat{d}}{dx} \right]$.

   (b) Differentiate between atomic spectra and molecular spectra.
   (c) What do you mean by zero point energy ?
   (d) Define Eigen value and Eigen Functions.
   (e) Give selection rule for Rotational and IR spectras.
   (f) How Quantum numbers originate from Schrodinger Wave equation ?
   (g) What is Born-Oppenheimer approximation ?

   $7 \times 1 = 7$