B.A./B.Sc. (General) 3rd Year

1046

CHEMISTRY

(Same for B.Sc. Microbiology & Food Technology)

Paper – XI : Physical Chemistry

Time Allowed : Three Hours]   **[Maximum Marks : 45**

Note : Attempt **one** question from each Unit. All questions carry equal marks. Question No. **IX** is compulsory.

UNIT–I

I. (a) Apply Schrondinger wave equation to a particle in a one-dimensional box and obtain the expression for the eigen function and eigen value of energy.   6

     (b) What is Sinusoidal Wave Function ? Represent it graphically.   3

II. (a) Using LCAO for wave function for H_2^+, obtain the normalised wave function for BMO and ABMO without neglecting the overlap integral.   5

     (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 ?   4

UNIT–II

III. (a) Derive the expression for the vibrational energy of a diatomic molecule, taking it as a simple harmonic oscillator. Represent the vibrational energy level of such a molecule diagrammatically.

6

(b) The far infrared spectrum of HI consists of a series of equally spaced lines with $\Delta \bar{v} = 12.8 \text{ cm}^{-1}$. What is : (a) the moment of inertia and (b) the internuclear distance ?

3

IV. (a) Explain with suitable mathematical equations the type of pure rotational Raman spectrum expected for a diatomic molecule. Mark clearly the separation between the different lines.

5

(b) Explain the formation of electronic band spectrum on the basis of potential energy curves. How do these curves help in the calculation of the dissociation energy of the molecules ?

4

UNIT–III

V. (a) What are elements of symmetry in crystallography ? Describe each of them briefly. Define the law of symmetry and give a suitable example to support your definition.

5

(b) Briefly describe the basic principles of each of the following X-ray diffraction methods for the study of crystal structures :

(i) Laue's method

(ii) Powder method.

4

VI. (a) Derive Bragg's equation for X-ray diffraction by crystals. 5

(b) What types of lattices have been observed for NaCl, KCl and CsCl crystals? Represent them diagrammatically. What are the coordinates of the different Na^+ and Cl^- ions in the crystal? 4

UNIT–IV

VII. (a) What do you understand by 'Luminescence'? Briefly explain the different types of luminescence. 5

(b) Calculate the value of Einstein of energy in electron volts for radiation of frequency $3 \times 10^{13} s^{-1}$. 4

VIII. (a) What do you understand by the quantum yield of a photochemical reaction? Why some reactions have high quantum yield whereas some have very low value? What is the modified definition of Stark-Einstein law? 5

(b) What mechanism has been proposed to explain:

(i) Photolysis of acetone

(ii) Photolysis of ammonia. 4

(Compulsory Question)

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

(b) What is the difference in the results obtained about heat capacities of solids when classical mechanics is applied and when quantum mechanics is applied?

(c) How are total values of ψ, E and $\hat{H}$ obtained for two independent systems A and B?

(d) What are P, Q and R branches of the vibration-rotation spectrum?

(e) What do you understand by the degrees of freedom of motion of a molecule?

(f) Define Steno's law of constancy of interfacial angles.

(g) Explain the terms 'Isomorphism' and 'Polymorphism' with suitable examples.

(h) Define Grotthus-Draper law.

(i) What is Photosensitisation? $1 \times 9 = 9$