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Exam. Code : 0475

M.Sc. Physics 4th Semester

(2053)

ATOMIC AND MOLECULAR PHYSICS

Paper : PHY–8042

Time Allowed : Three Hours] [Maximum Marks : 60

Note :—Attempt **FIVE** questions in all, selecting **ONE** question each from Unit I to IV. Unit V is compulsory.

UNIT–I

I. (a) State and explain Pauli's exclusion principle and discuss how this principle is connected with symmetry of the wave function.

(b) Outline the essential features of the spectra of alkaline earth elements. How are they explained theoretically ? 6,6

II. (a) Describe the fine structure of Hydrogen atom. What is Lamb shift ?

(b) Distinguish between LS and JJ coupling for two valance electron systems. Under what conditions can a transition from LS and JJ coupling scheme have been observed ? 6,6

UNIT–II

III. (a) State and explain Stark effect. Mention the condition for first order and second order Stark effect.

(b) Discuss Zeeman effect. Compute the Zeeman pattern for $^3D_3 \rightarrow {}^3P_2$ transition. 6,6

IV. (a) Explain the principle, construction and working of He-Ne Laser.

(b) Discuss the different modes of resonators and coherence length of Lasers. 6,6

UNIT–III

V. (a) What is Raman effect ? Discuss briefly the Raman spectra of diatomic molecules.

(b) Elaborate Born-Oppenheimer approximation. 6,6

VI. (a) Write down the expression for energy of rigid rotator model of a diatomic molecule and predict the pure rotational spectrum of the molecule.

(b) The force constant of the bond in CO molecule is 1870 Nm^{-1}. Find the energy of lowest vibrational level. The reduced mass of CO molecule is 1.14×10^{-26} kg. 9,3

UNIT–IV

VII. What type of elemental analysis can be done using Atomic Absorption Spectrometer ? Describe the experimental set up of this technique. 12

VIII. (a) Describe the working and construction of Raman Spectrometer.

(b) Explain briefly the following :

(i) Radiative and Auger transition

(ii) Inner shell ionization. 6,6

UNIT–V

IX. (a) Why electron spin resonance is also called electron paramagnetic resonance ?

(b) What is population inversion ? How is it achieved ?

(c) Write down the normalized wave function of a system of two Bose particles in the same quantum state.

(d) State Frank-Condon principle.

(e) How many electrons could be accommodated in n = 4 shell according to Pauli's exclusion principle ?

(f) Why four level laser is preferred over three level laser ? 6×2