Exam. Code : 209002
Subject Code : 4887

M.Sc. Physics 2nd Semester
ATOMIC & MOLECULAR SPECTROSCOPY
Paper : Phy-454

Time Allowed—2 Hours] [Maximum Marks—100

Note :— There are **EIGHT** questions of equal marks. Candidates are required to attempt any **FOUR** questions.

1. (a) State and prove Larmor's theorem.

   (b) Compute the possible terms and energy levels for a configuration with three optically active electrons 2p 3p 4d.

2. (a) Describe and explain the general features of spectra of alkali-like atoms.

   (b) Distinguish between L-S and J-J coupling schemes in the case of two-valance electron system.

3. (a) Discuss the Zeeman pattern for $^2D_{3/2} - {}^2P_{3/2}$ transition in one-electron atom.

   (b) Distinguish between the theory of natural breadth using classical theory and quantum mechanics.

4. (a) Distinguish between normal, anomalous Zeeman effect and Paschen-Bach effect.

   (b) Determine the Lande g-values for the various levels of 3P and 3D multiplets.

5. (a) Obtain an expression for the vibrational energy levels of a diatomic molecule.

   (b) The force constant of the bond in CO molecules is 1870 N/m. Find the energy of lowest vibrational level. The reduced mass of CO molecule is 1.14×10^{-26} Kg.

6. (a) Show that the absorption spectrum of a rigid rotator is expected to consist of a series of equidistant lines.

   (b) State giving reasons which of the molecules, H_2, N_2, HCl and OH will give pure rotational spectrum and which will give rotational Raman spectrum.

   (c) By what factor does the rotational constant changes when H^2 is substituted for H^1 in the hydrogen molecule ?

7. (a) The exciting line in an experiment is 5460 Å and the stokes lines is at 5520 Å. Find the wavelength of the anti-stokes line.

   (b) What is Raman effect ? Describe briefly the chief characteristics of vibrational and pure rotational Raman Spectra.

8. (a) Describe Frank Condon principle in emission and absorption. Discuss its importance.

   (b) The moment of inertia of the CO molecule is 1.46×10^{-16} Kg/m^2. Calculate the energy (in eV) and the angular velocity in the lowest rotational energy level of the CO molecule.