(i) **Printed Pages: 3** **Roll No. .....**

(ii) **Questions : 9** **Sub. Code :** 3723

Exam. Code : 0475

M.Sc. Physics 4th Semester

(2042)

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 Units I to IV. Q. No. **9** from Unit–V is compulsory to attempt.

UNIT–I

1. (a) Discuss the experimental evidence in support of electron spin. Also describe Stern-Gerlach experiment and its importance. 6

   (b) Explain L-S coupling and j-j coupling scheme with examples. 6

2. (a) Explain the Broad features of Alkali spectra. 6

   (b) Deduce terms of 3p, 4d configuration system in L-S and j-j couplings. Show with the help of diagram. 6

UNIT–II

3. (a) Write short notes on :

   (i) Natural Breadth

   (ii) Doppler Effect OR X-ray fluorescence. 6

   (b) Discuss hyperfine structure of spectral lines. How does this study help in the determination of the Nuclear spin ? 6

4. (a) Discuss the Stark effect and show that the First order Stark effect for the ground state of Hydrogen is zero. 6

(b) Explain the principle of Laser and essential requirements for producing the Laser action. Describe with a neat diagram the construction and working of a Ruby Laser. 6

UNIT–III

5. (a) What is Raman effect ? Give experimental arrangement of Raman spectra. Also give Classical and Quantum theory of Raman effect. 7

(b) In the Rotational Raman Spectrum of HCl, the displacements from the exciting lines are represented by

$$\Delta\nu = \pm (62.4 + 64.6\ J)\ cm^{-1}$$

Calculate the moment of inertia of HCl molecules ($h = 6.62 \times 10^{-27}$ erg-sec, $c = 3 \times 10^{+10}$ cm sec^{-1}). 5

6. (a) Explain Rotational Spectra of a diatomic molecules and explain how the moment of inertia of a molecules may be determined. 7

(b) Discuss Vibrational-Rotational Spectra of the molecules as a Harmonic Oscillator. 5

UNIT–IV

7. (a) What is the principle of ESR spectroscopy and what Instrumental Techniques are used in ESR spectroscopy ? Give significance of g-value. Also give applications of ESR. 6

   (b) Enumerate and deduce Moseley's Law and show how it is used in removing some of defects in the periodic table. 6

8. (a) What is the principle of NMR spectroscopy ? Give the working and experimental techniques in NMR spectroscopy. What is the significance of chemical-shift in NMR spectroscopy ? 6

   (b) What is FTIR-spectroscopy ? Give the basic principle of FTIR and what information FTIR gives. Give experimental of FTIR-spectrometer and applications. 6

UNIT–V

9. (a) Discuss how Pauli's principle is connected with the symmetry of the wave function.

   (b) How can you determine g-factor for DPPH ?

   (c) What is anomalous Zeeman effect ?

   (d) Write a short note on Paschen-Back effect.

   (e) What is Doppler Effect ? Explain with example.

   (f) Discuss the types of Molecular Spectra. 6×2=12