

Exam. Code : 209002

Subject Code : 4809

M.Sc. Physics 2<sup>nd</sup> Semester (Batch 2021-23)

**ATOMIC & MOLECULAR SPECTROSCOPY**

**Paper : Phy-454**

Time Allowed—3 Hours] [Maximum Marks—100

**Note** :— Attempt **FIVE** questions in all, selecting at least **ONE** question from each section. The fifth question may be attempted from any section. All questions carry equal marks.

**SECTION—A**

1. (a) Distinguish between L-S and j-j coupling schemes in the case of two valence electron systems. Under what conditions can a transition from L-S and j-j coupling scheme has been observed ? Illustrate your answer with examples. 14
- (b) Calculate the spin-orbit interaction splitting of a level corresponding to  $n = 2$  and  $l = 1$  of hydrogen atom. 6

2. (a) Outline the essential features of the spectra of alkaline-earth elements. How are they explained theoretically ? 14
- (b) Explain fine structure of alkali atoms on the basis of electron spin. 6

### SECTION—B

3. (a) Explain the origin of the shift in frequency and wavelength of the observed wavelength when observer and source moved toward or away from each other. 15
- (b) Apply the Doppler shift equations to any one real-world example. 5
4. (a) What is Zeeman effect ? Differentiate between normal and anomalous Zeeman effect. 15
- (b) Give examples of the Zeeman effect in some transitions. 5

### SECTION—C

5. Discuss rotational spectrum of a diatomic molecule, treated as a rigid rotator and non rigid rotator. 20
6. (a) What is Fourier transform spectroscopy ? 5
- (b) Discuss the simple harmonic and anharmonic oscillator model for a vibrating diatomic molecule. 15

## SECTION—D

7. (a) Discuss the quantum theory of Raman effect and describe the rotational structure of the Raman spectrum of a diatomic molecule. 15
- (b) With exciting line  $2536 \text{ \AA}$  Raman line for a sample is observed at  $2612 \text{ \AA}$ . Calculate the Raman shift in  $\text{cm}^{-1}$ . 5
8. (a) Discuss Born Oppenheimer approximation. Where it is useful ? 10
- (b) Explain Fortrat diagram with the help of an example of spectrum of molecular hydrogen. 10