



QP CODE: 23002672



23002672

Reg No : .....

Name : .....

**M Sc DEGREE (CSS) EXAMINATION, MARCH 2023**

**Third Semester**

Faculty of Science

M Sc PHYSICS

**CORE - PH010303 - ATOMIC AND MOLECULAR PHYSICS**

2019 ADMISSION ONWARDS

01E0AE59

Time: 3 Hours

Weightage: 30

**Part A (Short Answer Questions)**

*Answer any **eight** questions.*

*Weight **1** each.*

1. Distinguish between normal and anomalous Zeeman effects
2. Briefly explain hyper-fine structure
3. The observed rotational spectrum of HF shows decrease in the line separation on the high frequency side. why?
4. Homo-nuclear diatomic molecules like  $H_2$ ,  $N_2$  do not show rotational spectra. why?
5. Explain the Stokes radiation in Raman scattering.
6. Explain rule of mutual exclusion.
7. Explain Franck Condon principle.
8. What is resonance frequency in NMR?
9. What is unit of chemical shift?
10. Why Mossbauer spectroscopy is well suited for biological applications?

(8×1=8 weightage)

**Part B (Short Essay/Problems)**

*Answer any **six** questions.*

*Weight **2** each.*

11. Find the interaction energy for L-S coupling for combination of s and p electrons.





12. Explain Hund's rule with examples.
13. Given that the spacing of the lines in the microwave spectrum of  $^{27}\text{Al}^1\text{H}$  is constant at  $12.604\text{cm}^{-1}$ , calculate the moment of inertia and bond length of the molecule. ( $m_{^{27}\text{Al}} = 26.9815\text{ amu}$ ).
14. The fundamental band for HCl is centred at  $2886\text{cm}^{-1}$ . Assuming that the inter nuclear distance is  $1.276\text{ \AA}$  calculate the wavenumber of first two lines of each of the P and R branches of HCl.
15. A substance shows Raman line at  $4567\text{ \AA}^0$  when excited by  $4358\text{ \AA}^0$  line. Deduce the positions of Stoke's line and anti-Stoke's lines for the same substance when the exciting line is  $4047\text{ \AA}^0$ .
16. Describe the inverse Raman effect.
17. Explain the principle of ESR.
18. Explain the components which contribute towards total Hamiltonian of a system.

(6×2=12 weightage)

### Part C (Essay Type Questions)

Answer any **two** questions.

Weight **5** each.

19. Explain the hydrogen spectra along with different quantum numbers.
20. Prove that anharmonic oscillator behaves like a harmonic oscillator but with an oscillating frequency decreasing with increasing vibrational quantum number.
21. Obtain the rotational fine structure of electronic vibrational spectra. What will happen if  $B' > B''$  and  $B' < B''$ ?
22. Write an essay on the applications of Mossbauer spectroscopy.

(2×5=10 weightage)

