



QP CODE: 22000734



22000734

Reg No :

Name :

M Sc DEGREE (CSS) EXAMINATION, APRIL 2022

Third Semester

Faculty of Science

M Sc PHYSICS

CORE - PH010303 - ATOMIC AND MOLECULAR PHYSICS

2019 ADMISSION ONWARDS

0739A691

Time: 3 Hours

Weightage: 30

Part A (Short Answer Questions)

Answer any **eight** questions.

Weight **1** each.

1. Prove that the spin angular momentum vector S precesses around a magnetic field B twice as fast as orbital angular momentum vector L
2. Write the spectroscopic notation for all possible single electron states if $n=4, l=1$.
3. Briefly explain about the width of spectral lines.
4. Write a brief note on P and R branches in the rotational- vibrational spectra.
5. Explain the properties of Rotational Raman spectrum?
6. State the conditions for a vibration to be Raman active.
7. What is Born-Oppenheimer approximation ?
8. What is g value in ESR spectroscopy?
9. Explain Mossbauer sources and absorbers.
10. How is electron density related to chemical isomer shift?

($8 \times 1 = 8$ weightage)

Part B (Short Essay/Problems)

Answer any **six** questions.

Weight **2** each.

11. Describe the splitting of spectral lines of sodium atom using anomalous Zeeman effect.





12. Consider a hydrogen atom in the $D_{3/2}$ state. Find the possible values of J_z . What are the different orientation of J vector in space?
13. The value of ω_e and $\omega_e \chi_e$ are 1580.36 and 12.073 cm^{-1} respectively for the ground state of molecular origin. Calculate its zero point energy. ($1\text{eV}=8068 \text{ cm}^{-1}$)
14. What are the different possible modes of vibration in CO_2 and H_2O molecule. Explain.
15. Bring out the structural determination from Raman spectra.
16. With neat diagram explain how the inter-nuclear distance of lower and upper electronic levels affect the spectrum of vibrational- electronic transitions.
17. NMR spectrum of a compound occurs at 10.705 MHz in a magnetic field of 1 Tesla . What is the resonance frequency if the field applied is 3 Tesla ?
18. Explain Hyperfine structure.

(6×2=12 weightage)

Part C (Essay Type Questions)

Answer any **two** questions.

Weight **5** each.

19. Derive an expression for the spin orbit interaction energy.
20. Describe rotational levels and spectra of a non rigid rotator.
21. Obtain the intensity pattern of vibrational electronic spectra.
22. Briefly explain chemical shift and indirect spin-spin coupling process in NMR spectroscopy with examples.

(2×5=10 weightage)

