25047327

QP CODE: 25047327

Reg No : .....

Name : .....

M.Sc DEGREE (CSS) EXAMINATION, NOVEMBER 2025

Third Semester

M Sc PHYSICS

Core Course - PH010303 - ATOMIC AND MOLECULAR PHYSICS

2019 ADMISSION ONWARDS

C2DDFC5A

Time: 3 Hours Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

*Weight **1** each.*

1. What is Larmour Precession?
2. Explain Stark Effect and its main features.
3. The intensity of J=1 to J=0 is often not the most intense rotational line. why?
4. Diatomic molecules such as CO,HF will show rotational spectrum while N_2 , O_2, H_2, … will not. Why?
5. Discuss the quantum theory of Raman effect.
6. Explain progression and sequences in vibrational coarse structure.
7. Explain the principle of intensity distribution of vibrational electronic spectra.
8. What is shielding constant in NMR spectroscopy?
9. List the basic requirements of NMR spectrometer.
10. What is the criteria of electronic spin resonance?

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

*Weight **2** each.*

11. Show that the Lande's g factor is a dimensionless number which varies from state to state.
12. Find the possible values of the total angular momentum quantum number: J under jj coupling of two atomic electrons where orbital quantum numbers are $l_1 = 1$ and $l_2 = 2$.

13. What is the effect of isotopic substitution in the rotational spectrum? Estimate the atomic weight of carbon atom if the first rotational absorption of $^{12}C^{16}O$ is at 3.84235 cm^{-1} while that of $^{13}C^{16}O$ is at 3.67337 cm^{-1}.

14. What are the two fundamental aspects to analyse the IR spectra?

15. A molecule AB_2 has the following IR and Raman spectra. Discuss the molecular structure and assign the observed lines to molecular vibration. Frequency 3750 Hz is very strong in IR. But no line in Raman. Frequency 3650 Hz is very strong in IR and Strong and polarised in Raman also. Frequency 1595 Hz is very strong in IR and no line in Raman.

16. In rotational fine structure of electronic transition there will not be spectral line appearing on band origin. Explain.

17. Explain relaxation process in NMR.

18. Calculate the recoil velocity of a free Mossbauer nucleus of mass 1.67×10^{-25}kg, which is equivalent to atomic weight 100, when emitting a gamma ray of wavelength 0.1nm. What is the Doppler shift of the gamma ray frequency to an outside observer?

(6×2=12 weightage)

Part C (Essay Type Questions)

*Answer any **two** questions.*

*Weight **5** each.*

19. Bring out the spectra of hydrogen atom along with various quantum numbers.

20. Explain the spectra of diatomic vibrating rotators and also discuss the breakdown of Born- Oppenheimer approximation.

21. Explain vibration and rotational fine structure of Raman spectroscopy.

22. Explain the concept of high resolution Hamiltonian in ESR.

(2×5=10 weightage)