M Sc DEGREE (CSS) EXAMINATION, MARCH 2021

Third Semester

Faculty of Science

M Sc PHYSICS

CORE - PH010303 - ATOMIC AND MOLECULAR PHYSICS

2019 Admission Onwards

CECD0ED8

Time: 3 Hours   Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

*Weight **1** each.*

1. Explain the intensity rule for fine structure doublet. Give an example

2. Obtain the lowest spectral term of carbon atom.

3. Represent in a diagram, the electronic, rotational and vibrational energy levels of a diatomic molecule.

4. Represent the vibrational energy levels and allowed transitions for a diatomic molecule undergoing SHM.

5. All the three H_2O molecular vibrations are Raman active. Explain

6. Give the difference between vibrational coarse structure and rotational fine structure

7. Explain the rotational fine structure of electronic vibrational spectra

8. In NMR spectrum of acetaldehyde the proton resonance is different for CH_3 and CHO. Why?

9. What is NMR imaging? Explain it.

10. What is the difference between ESR and NMR?

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

*Weight **2** each.*

11. Draw the normal Zeeman pattern for the $^1F_3$ to $^1D_2$ transition.

12. Prove that Paschen-Back effect is a triplet as in normal Zeeman effect

13. Explain Doppler broadening.

14.

   Given the spacing between vibrational levels of a CO molecule as 8.45×10^{-2} eV, calculate the force constant of the bond in the CO molecule.

15. In rotational Raman spectrum of HCI, the shift from exciting lines are represented by $\Delta\bar{\nu} = (62.4 + 41.67J)cm^{-1}$. Evaluate a) the rotational constant b) bond length of HCl molecule

16. Explain Hyper Raman, Stimulated Raman and Inverse Raman effect.

17. Calculate the strength of the magnetic field to give a precessional frequency of 100 MHz for ^{17}O nucleus. $g_N = -0.757$, I=5/2.

18. Briefly explain the quadrupole interaction in Mossbauer spectroscopy.

(6×2=12 weightage)

Part C (Essay Type Questions)

*Answer any **two** questions.*

*Weight **5** each.*

19. What is jj coupling? Derive the expression for the interaction energy in jj coupling scheme.

20. Discuss vibrational -rotational spectra of diatomic molecule. Explain how the P, Q and R branches occur in the vibrational -rotational spectra

21. Discuss electronic spectra of diatomic molecules with theory.

22. Explain Mossbauer Effect. Discuss the experimental set up for Mossbauer spectra along with theory.

(2×5=10 weightage)