



QP CODE: 24044707



24044707

Reg No :

Name :

M.Sc DEGREE (CSS) EXAMINATION, OCTOBER 2024
Third Semester
CORE - PH010303 - ATOMIC AND MOLECULAR PHYSICS

M.Sc PHYSICS
2019 ADMISSION ONWARDS
D7737B6C

Time: 3 Hours

Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

Weight 1 each.

1. Briefly explain the quantum numbers used to specify the state of hydrogen atom.
2. Explain how atomic states are represented in L-S and jj coupling schemes.
3. Explain the selection rule of rotational Raman spectra of a symmetric top molecule.
4. What is Fermi resonance in vibrational spectroscopy?
5. In H_2 molecule the separation between adjacent rotational Raman lines is $4B$, but in O_2 molecule it is $8B$. Why?
6. What are CARS ?
7. What is the principle that governs the vibrational course structure analysis?
8. State the applications of chemical shift.
9. Draw the block diagram of NMR spectrometer.
10. Draw the block diagram of ESR spectrometer.

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

Weight 2 each.

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





12. Find the possible values of the total angular momentum quantum number: J under LS coupling of two atomic electrons where orbital quantum numbers are $l_1 = 1$ and $l_2 = 2$.
13. Rotational and centrifugal distortion constant of HCl molecule are 10.593 cm^{-1} and $5.4 \times 10^{-4} \text{ cm}^{-1}$ respectively. Estimate the vibrational frequency and force constant of the molecule
14. Explain the P and R branches in the rotational- vibrational spectra.
15. Discuss the relevance of IR spectroscopy.
16. What is predissociation ? Also obtain the diagrammatic representation.
17. In the NMR spectrum of ^{14}N with $I = 1$, how many spectral lines will be observed? Calculate the frequency required for the NMR line at an external field of 1.4 T, $g_N = 0.403$.
18. Write a note on isomer shift in Mossbauer spectroscopy.

(6×2=12 weightage)

Part C (Essay Type Questions)

Answer any **two** questions.

Weight **5** each.

19. Differentiate Normal and Anomalous Zeeman effect. Describe the quantum theory of anomalous Zeeman effect
20. Explain the four informations about a molecule that is obtained from a rotational spectra.
21. Explain the Raman activity of vibrations of CO_2 and H_2O molecule.
22. What is Mossbauer spectroscopy? Discuss the principle and applications of Mossbauer spectroscopy.

(2×5=10 weightage)

