D4APH2201 **(2 Pages)** **Name.....**
Reg.No.....

FOURTH SEMESTER M.Sc. DEGREE EXAMINATION, APRIL 2024
(Regular/Improvement/Supplementary)

PHYSICS
FPHY4C12 - ATOMIC AND MOLECULAR SPECTROSCOPY

Time: 3 Hours **Maximum Weightage: 30**

Part A: Short answer questions. Answer *all* questions. Each carries *one* weightage.

1. Explain Hund's rule with example.
2. What are hot bands? Why are they called so?
3. Illustrating an example, explain mutual exclusion principle.
4. Write a short note on Stimulated Raman Scattering.
5. Outline the principle of NMR.
6. Write any two important information that can be obtained from rotational spectroscopy.
7. Diatomic molecules such as CO and HI will show a rotational spectrum, whereas N_2, H_2, O_2 etc. will not. Why?
8. Distinguish between normal Zeeman effect and anomalous Zeeman effect.

(8 × 1 = 8 weightage)

Part B: Essay questions. Answer any *two* questions. Each carries *five* weightage.

9. Derive an expression for rotational energy levels of a symmetric top molecule. Discuss its spectrum and relevant selection rules.
10. Give an outline on the vibrational analysis of the band systems in electronic spectra of molecules using Deslander's table.
11. With neat diagram explain the working of Raman Spectrometer.
12. Discuss the principle involved in Mossbauer spectroscopy. Discuss isomer shift with example.

(2 × 5 = 10 weightage)

Part C: Problems. Answer any *four* questions. Each carries *three* weightage.

13. Draw the anomalous Zeeman pattern of the D_1 and D_2 lines of sodium and obtain their frequencies.
14. Consider two electrons, one in the 4p and the other in 4f subshell. Obtain the possible L, S and J values for this two electron system.

(P.T.O.)

15. With necessary energy level diagram explain how dissociation take place.
16. What is the change in the rotational constant B when hydrogen is replaced by deuterium in the hydrogen molecule?
17. If the bond length of H_2 is 0.07417 nm, what would be the positions of the first three rotational Raman lines in the spectrum? What is the effect of nuclear spin on the spectrum? (^1H = 1.673 x 10^{-27} Kg).
18. A Mossbauer nucleus ^{57}Fe makes the transition from the excited state of energy 14.4 KeV to the ground state. What is its recoil velocity?
19. Calculate the magnetic field strength required to get a transition frequency of 60 MHz for fluorine $(g_N = 5.255)$.

(4 × 3 = 12 weightage)