

D 143227

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Name.....

Reg. No.....

**FOURTH SEMESTER M.Sc. DEGREE (REGULAR/SUPPLEMENTARY)
EXAMINATION, APRIL 2026**

(CBCSS)

Physics

PHY 4C 12—ATOMIC AND MOLECULAR SPECTROSCOPY

(2019 Admission onwards)

Time : Three Hours

Maximum : 30 Weightage

Section A*8 Short questions, each answerable within 7.5 minutes.**Answer **all** questions, each question carries weightage 1.*

1. What is J-J coupling ?
2. Which property of sun is used by Zeeman effect ?
3. What is a symmetric top ? Give example
4. What is the range of the infrared spectrum ?
5. Define Stokes and anti stokes lines.
6. Explain Hyper Raman effect
7. Define the term dissociation energy in vibrational spectroscopy.
8. Define Chemical shift.

(8 × 1 = 8 weightage)

Section B*4 Essay questions, each answerable within 30 minutes.**Answer any **two** questions, each question carries weightage 5.*

9. Define and Compare Zeeman effect and Paschen back effect.
10. With the example of CH₃Cl, explain the rotational spectra of symmetric top molecules.

Turn over

11. Explain, how the intensities of the lines in the rotation and rotation-vibration spectrum are modified by Born Oppenheimer.
12. With example explain the rotational Raman spectrum of a symmetric top molecule.

(2 × 5 = 10 weightage)

Section C

7 Problem questions, each answerable within 15 minutes.

*Answer any **four** questions; each question carries weightage 3.*

13. Couple a *p*-state and an *s*-state electron via :
 - (a) L-S coupling.
 - (b) J-J coupling.
14. The third lowest microwave absorption frequency for $^{13}\text{C}^{16}\text{O}$ is 330567 M.Hz. Calculate the second lowest absorption frequency for $^{12}\text{C}^{16}\text{O}$.
15. The $J = 0 \rightarrow J = 1$ absorption line in CO occurs at a frequency of 1.153×10^{11} cycles/sec. Calculate the moment of inertia and internuclear separation of CO.
16. The OH-radical has a moment of inertia of 1.48×10^{-40} gm cm². Calculate its internuclear distance
17. The H₂ molecule has a reduced mass 8.35×10^{-28} kg. and an equilibrium internuclear distance $R = 0.742 \times 10^{-10}$ m. What is the rotational energy in terms of the rotational quantum number ?
18. Briefly explain Recoilless emission of gamma rays.
19. Briefly explain longitudinal and transverse relaxation.

(4 × 3 = 12 weightage)