

26024144



26024144



Reg. No.....

Name.....

M.Sc. DEGREE (C.S.S.) EXAMINATION, MAY 2026

Fourth Semester

Faculty of Science

Branch II – Physics (A) – Pure Physics

PH4C11—ATOMIC AND MOLECULAR PHYSICS

(2016-2018 Admissions—Mercy Chance)

Time : Three Hours

Maximum Weight : 30

Part A

*Answer any **six** questions.*

Each question carries a weight of 1.

1. Give the fine structure of sodium atom.
2. What is the Zeeman Effect ?
3. Write down the spin-orbit interaction energy for a hydrogenic atom.
4. What is a non-rigid rotor ?
5. Write down the features of symmetric top molecule. List applications.
6. What is the Born-Oppenheimer approximation ?
7. State Franlo-Condon principle.
8. What is inverse. Raman effect ?
9. What is the difference between ESR and NMR ?
10. What is the significance of spin -spin coupling ?

(6 × 1 = 6)

Part B

*Answer any **four** questions.*

Each question carries a weight of 2.

11. Briefly discuss on the quantum numbers associated with the hydrogen atom.
12. Consider a hydrogen atom in the $D_{3/2}$ state. (i) Find the possible values of I_z ; (ii) What are the 2 different orientations of the J-vector in space.

Turn over





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13. In the infra-red spectrum of HCl molecule there is a single intense band at 2885.9 cm^{-1} . Assuming that it is due to the transition between vibrational levels, show that the force constant is 480 Nm^{-1} .
14. The first three rotational Raman lines of a linear triatomic molecular are at 4.86, 8.14 and 11.36 cm^{-1} from the exciting Raman lines. Estimate the rotational constant B and the moment of inertia of the molecule.
15. Write a short note on Fourier Transform spectroscopy and its advantages.
16. Describe the working of an Electron Spin Resonance (ESR) spectrometer.

(4 × 2 = 8)

Part C

Answer all questions.

Each question carries weight of 4.

17. (a) Explain in detail the theory of Paschen-Back effect.

Or

- (b) Discuss in detail L S and jj coupling schemes in many electron atoms. Give examples.

18. (a) Explain the rotational spectra of diatomic molecules.

Or

- (b) Explain overtone and combination frequencies in IR spectroscopy.

19. (a) State the rule of mutual exclusion. Explain structure determination using IR and Raman spectroscopy.

Or

- (b) Explain the electronic spectra of diatomic molecules with suitable energy level diagrams.

20. (a) Explain in detail : (i) Relaxation process in NMR ; and (ii) Theory of chemical shift with an example.

Or

- (b) What is the Mössbauer effect ? Explain its physical basis and conditions necessary for its observation.

(4 × 4 = 16)

