

M.SC.(Physics) Semester - 2 (CBCS) Examination**April/May-2023 (NEW COURSE)****Atomic and Molecular Physics****Time: 2:30 Hours****Marks: 70****Instructions:**

1. All questions are compulsory.
2. Figures to the right indicate marks.

Q.1 Answer any SEVEN of the following: (14)

- (a) Why the hydrogen spectrum is not in X-ray region?
- (b) In case of three electrons, what should be the possible values of spin angular momenta? Give the reason of your answer.
- (c) What is Pauli's exclusion principle?
- (d) How Paschen-back effect is different from normal Zeeman Effect?
- (e) Differentiate the rigid and the non-rigid rotator?
- (f) When an atom in a molecule is replaced by one of its isotopes, what is the effect of this replacement on the interbond distance and the moment of inertia of that molecule? Why?
- (g) What are the moments of inertia relations for the Prolate and Oblate symmetric molecules?
- (h) Whom do you call IR-region in electromagnetic spectrum? Explain each sub-division of IR-region with reference to its usefulness.
- (i) What is the importance of "Fore Optics" in IR Spectrophotometer?
- (j) What are hot bands?

Q.2 Answer any TWO of the following: (14)

- (a) Explain the fine structure of Hydrogen Atom Spectrum.
- (b) Discuss the orbital and spin angular momentum of electron.
- (c) How electrons occupy the orbitals in the large atoms? Explain in detail.

Q.3 (a) Discuss the magnetic moment of electron due to its orbital motion. (07)**(b) Discuss the experimental arrangement and main features of the Stark effect. (07)****OR****Q.3 (a) Explain the rotational spectra of rigid diatomic molecules depicting the energy levels and transitions. (07)****(b) Discuss non-rigid rotator in detail comparing the energy levels and spectra of rigid and non-rigid rotators. (07)****Q.4 Answer any TWO of the following: (14)**

- (a) Discuss Symmetric Top Molecules showing the schematic representation of energy levels and transitions for the rigid prolate and rigid oblate symmetric rotors.
- (b) Discuss the first order Stark Effect of a Symmetric Top Molecule for the $J=1, K=1 \rightarrow J=2, K=1$ transition.
- (c) Discuss the Morse curve and the energy levels of a diatomic molecule.

Q.5 Write a Short-note on any TWO of the following: (14)

- (a) IR Spectrophotometer
- (b) Diatomic Vibrating Rotator
- (c) Normal Vibrations of CO_2 and H_2O molecules
- (d) L-S coupling and j-j coupling.
