

M.Sc. (Physics) Semester - 2 (CBCS) Examination
August/September -2020 [NEW COURSE]
Atomic and Molecular Physics (CORE)

Time: 2:00 Hours

Marks: 56

Instructions:

1. Figure to the right indicate marks.
 2. There are five questions in the question paper.
 3. Answer any four of the following questions.
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Q – 1: Answer any **Seven:**

14

- (a) In case of four electrons, what should be the possible values of spin angular momenta?
Give the reason of your answer.
- (b) Is transition $^2P_{3/2} \rightarrow ^2D_{3/2}$ is allowed? Give the reason of your answer on the basis of selection rule.
- (c) What do you mean by L-S coupling? When this coupling takes place?
- (d) Draw the diagram of precession of Spin vector S, Orbital vector L and Total vector J around external magnetic field direction when the field is weak and strong.
- (e) What are rigid and non-rigid rotators?
- (f) Transition originating from the level having which J value will have the maximum intensity?
- (g) What quantum numbers J and K represents?
- (h) What are near prolate and near oblate asymmetric rotors?
- (i) What are the hot bands?
- (j) Depict the normal vibrations of CO₂ molecule.

Q – 2: Write any **Two:**

14

- (a) What are building up rules? On their basis, explain how electrons occupy orbitals in large atoms.
- (b) Discuss orbital angular momentum, spin angular momentum and total angular momentum of the electron.
- (c) Discuss the fine structure of Hydrogen atom spectrum.

Q – 3: Answer the following questions: **ALL ARE COMPULSORY**

- (a) Discuss the two concepts of vector atom model. 07
- (b) Discuss the magnetic moment of electron due to its orbital and spin motion. 07

OR

Q – 3: Answer the following questions: **ALL ARE COMPULSORY**

- (a) How molecules are classified based on the relative values of Principal moments of inertia? Explain with examples. 07
- (b) Discuss non-rigid rotator in detail. Also compare the energy levels and spectrum of rigid and non-rigid rotators. 07

Q – 4: Write any **Two:**

14

- (a) Discuss the first order Stark effect of a symmetric top molecule for the $J = 1, K = 1 \rightarrow J = 2, K = 1$ transition.
- (b) Discuss the Morse curve and the energy levels of a diatomic molecule.
- (c) Explain asymmetric top molecules in detail showing the energy level correlation diagram for asymmetric rotor.

Q – 5: Write notes on any **Two:**

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- (a) Selection rules.
- (b) Symmetric stretching, bending and asymmetric stretching in H₂O molecule.
- (c) IR spectrophotometer.
- (d) Diatomic vibrating rotator.
