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MPHY-604

Atomic and Molecular Spectroscopy

M.Sc Physics (MSCPHY-20)

3rd Semester Examination, 2022 (June)

Time : 2 Hours] **Max. Marks : 40**

Note : This paper is of Forty (40) marks divided into two (02) Sections A and B. Attempt the questions contained in these sections according to the detailed instructions given therein.

SECTION–A

(Long Answer Type Questions)

Note : Section 'A' contains Five (05) long answer type questions of Ten (10) marks each. Learners are required to answer any Two (02) questions only.

(2×10=20)

1. Give the main features of pure rotational band spectrum of a heteronuclear diatomic molecule. Discuss rotational spectrum of diatomic molecule treated it as rigid and non-rigid rotator.

2. What is stark effect? Discuss the weak field stark effect and the strong field stark effect in Hydrogen?

3. What is Raman Effect? Discuss how the change in polarizability leads to appearance of Stokes and Anti-stokes lines. In what ways does it differ from Infrared spectra?

4. What do you understand by Zeeman effect? Discuss the normal and anomalous Zeeman effect. Compute the Zeeman pattern for $^2D_{3/2} \rightarrow {}^2P_{1/2}$ transition.

5. Discuss the qualitative features observed in electronic spectrum of a diatomic molecule and explain how they are modified if vibration rotation interaction is also considered.

SECTION–B

(Short Answer Type Questions)

Note : Section 'B' contains Eight (08) short answer type questions of Five (05) marks each. Learners are required to answer any Four (04) questions only. (4×5=20)

1. Write a short note on Frank-Condon principle.

2. Explain L-S and J-J coupling with suitable example.

3. Determine the rotational energy of a molecule on the quantum levels J=l and J=2 if the equilibrium nucleus distance of CO is 1.131 Å.

4. Briefly discuss the energy level diagram of Helium atom.

5. The ground state of chlorine atom is $^2P_{3/2}$. Find its magnetic moment. Into how many substates this ground state will split in a weak magnetic field.

6. What do you mean by Lande g factor? Compute the Lande g factor for an atom in the state $^2D_{5/2}$.

7. The fundamental and the first overtone for CO are 2143.26 cm^{-1} and 4260.04 cm^{-1}. Find the equilibrium vibrational frequency and anharmonicity constant for CO.

8. Show that the Rotational spectrum of rigid rotator consists of equidistant lines with constant separation.
