

**CARMEL COLLEGE OF ARTS, SCIENCE & COMMERCE FOR
WOMEN, NUVEM - GOA.**

SEMESTER END EXAMINATION, JULY 2021

Semester: VI of B.Sc. Physics PYC 108 Atomic and Molecular Physics

Total Marks: 30 Date: 9/7/2021 Duration: 2 Hours Total No of pages: 2

Instructions:

1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Symbols have their usual meaning unless specified.
4. Use of nonprogrammable calculator is permitted.
5. Draw neat diagrams wherever necessary.

1. Answer any five of the following: 5 x 2=10

- a) What is meant by space quantization. What is the physical significance of orbital quantum number m_l .
- b) State Pauli's exclusion principle and Hund rule. How does it explain ferromagnetism in Fe^{26} .
- c) Determine the values of total angular momentum for f electron.
- d) What inferences are drawn from the results Stern-Gerlach experiment ? What is the significance of this experiment?
- e) Estimate the relative intensities of the lines of compound doublets. Arising from the transition ${}^2\text{F} \rightarrow {}^2\text{D}$
- f) In the CO molecule the bond length is 1.13 A.U. and mass of carbon and oxygen atom is 1.99×10^{-26} kg and 2.66×10^{-26} kg respectively. Calculate the energy of the lowest rotational energy level.
- g) The bond length of Hydrogen molecule is 0.7417 \AA and the mass of Hydrogen atom is 1.67×10^{-24} gm. Find the frequencies of first three lines of Raman spectra
- h) State Frank-Condon principle and explain the origin of electronic spectra.

2. Answer any **Four** of the following:

5 x 4 =20

- a) Give Schrodinger wave equation for hydrogen atom in spherical polar co-ordinates. The azimuthal wave function for the hydrogen atom is $\Phi(\varphi) = Ae^{im_l\varphi}$. Show that the value of the normalisation constant A is $1/(\sqrt{2\pi})$.
- b) What are symmetric and antisymmetric wave functions? Show that the system of electrons must be described by antisymmetric wave functions in order that their behavior is consistent with Pauli's exclusion principle.
- c) Explain Zeeman Effect. Discuss normal Zeeman effect and derive expression for Zeeman splitting.
- d) State and explain Moseley's law. Calculate the K fluorescence yield in the case of an element, if out of 165 K photoelectrons tracks, 153 are accompanied by Auger tracks.
- e) Obtain the frequency of vibration of a molecule in terms of reduced mass. Hence get an expression for the separation between two vibrational energy levels.
- f) Explain with the help of a neat diagram the experimental set up used to study the Raman effect.