RDN – 09

B.Sc. (Semester – VI) Examination, April/May 2019
PHYSICS
Atomic and Molecular Physics

Duration : 2 Hours | Total Marks : 80

Instructions : *1) **All** questions are **compulsory**.*
*2) Figures to the **right** indicate **full** marks.*
*3) **Use** of calculators **allowed**.*
*4) Symbols have their **usual** meaning.*

1. Answer **any four** of the following questions : **(4×4=16)**
   a) Explain space quantization of orbital angular momentum.
   b) State Pauli's exclusion principle. What conclusions can be drawn from it ?
   c) Explain Stern-Gelarch experiment.
   d) Explain principal and sharp series lines of alkali metal spectra.
   e) Explain Auger effect and fluorescent yield.
   f) Explain the concept of equivalent and non-equivalent electrons.

2. Answer **any four** of the following questions : **(4×4=16)**
   a) Explain why simple assymmetric top molecule like water is Raman active.
   b) State and explain Frank-Condon principle.
   c) Explain in brief Fortrat parabolas.
   d) Write a note on continuous X-ray spectra.
   e) Write a short note on L-S coupling.
   f) Show that for a diatomic molecule its moment of inertia about an axis perpendicular to the line joining the two atoms and passing through the centre of mass of the system $I = \mu r_0^2$ where μ is the reduced mass of the molecule and r_o is its internuclear distance.

3. A) P) What are Bosons and Fermions ? Give one example of each. **3**
   Q) A beam of electrons enters a uniform magnetic field of flux density 1.4 Tesla. Find the energy difference between the electrons whose spins are parallel and antiparallel to the field. **3**

   OR

P.T.O.

X) Define symmetric and antisymmetric wave functions and name the two particles for which the wave function is symmetric and antisymmetric. 3

Y) Find the values of S, L and J that corresponds to each of the following states : $^2D_{3/2}$, $^6H_{5/2}$, $^1S_0$. 3

B) Write down Schrodinger's equation in spherical polar co-ordinates for hydrogen atom and obtain solutions for its radial and azimuthal part. 6

4. A) P) Give classical explanation of normal Zeeman effect. 3

Q) An electron in the circular orbit has angular momentum $\sqrt{2}\,\hbar$ in a field of 0.5 T. Calculate Larmor frequency. 3

OR

X) Write a note on J-J coupling. 3

Y) What are selection rules for normal Zeeman effect ? Illustrate it by drawing suitable energy level diagrams. 3

B) Explain Anamalous Zeeman effect taking help of suitable transitions. 6

5. A) P) Explain Raman effect using classical mechanics. 3

Q) Explain the origin of characteristic X-ray spectra. 3

OR

X) Describe vibrational Raman spectra. 3

Y) State Moseley's law. How it is useful to remove anamolies from the periodic table ? 3

B) Explain Rotation – Vibration Raman spectra. 6

6. A) P) Explain how the rotational energy levels of diatomic molecule get modified when we consider it to be a non rigid rotator. 3

Q) Force constant of CO molecule is 187 N/m. The reduced mass of CO molecule is 1.14×10^{-26} kg. Obtain frequency of its vibrations and spacing between two vibrational energy levels. 3

OR

X) Explain how the energy levels of a diatomic molecule get modified when we consider it to be non harmonic oscillator. 3

Y) The adjacent lines in the pure rotational spectra of Cl^{35} F^{19} are separated by frequency of 1.12×10^{10} Hz. What is interatomic distance in this molecule ? 3

B) Describe rotation – vibration spectra of a diatomic molecule, considering it to be rigid rotator and harmonic oscillator. 6
