



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)

- Explain space quantization of orbital angular momentum.
- State Pauli's exclusion principle. What conclusions can be drawn from it ?
- Explain Stern-Gelarch experiment.
- Explain principal and sharp series lines of alkali metal spectra.
- Explain Auger effect and fluorescent yield.
- Explain the concept of equivalent and non-equivalent electrons.

2. Answer **any four** of the following questions : (4×4=16)

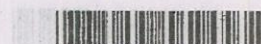
- Explain why simple assymmetric top molecule like water is Raman active.
- State and explain Frank-Condon principle.
- Explain in brief Fortrat parabolas.
- Write a note on continuous X-ray spectra.
- Write a short note on L-S coupling.
- Show that for a diatomic molecule its moment of inertia about 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  $\mu$  is the reduced mass of the molecule and  $r_0$  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





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 Anomalous 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 anomalies 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  $1.14 \times 10^{-26}$  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  $1.12 \times 10^{10}$  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