

# PHYSICS

## Paper-C : Quantum Physics – II

Time Allowed : 3 Hours

Maximum Marks : 22

- Note : (i) Attempt five questions in all, selecting two questions from each Sections A and B. Section C is compulsory.
- (ii) Use of non-programmable calculator or log table is allowed.

### SECTION – A

1. (a) Show that transition probability of electric dipole is directly proportional to the energy density of the radiation. For one electron atomic system interacting with radiation, what are the allowed transitions ? Explain. 2
- (b) What is normal Zeeman effect ? Explain it with necessary theory and derive the expression for Zeeman shift ? 2
2. (a) What is spin-orbit coupling ? Find an expression for energy due to spin-orbit interaction. 2
- (b) What is Lande's  $g$ -factor of an electron ? How does it explain the splitting of levels and fine structure of hydrogen atom ? 2

3. (a) Explain space quantization and spinning of an electron. 2  
(b) Calculate the value of Lande's  $g$ -factor for  $p$ -electrons. 2

### SECTION – B

4. (a) State and explain Pauli's exclusion principle. Prove the total wavefunction of identical fermions is antisymmetric. 2  
(b) Describe helium atom spectrum and discuss the difference between orthohelium and parahelium. 2
5. (a) What is Auger effect? Explain, how it takes place. What conclusion can be drawn from these? 2  
(b) State Moseley's law and find its importance in finding the element whose  $K_{\alpha}$  line of wavelength  $\lambda = 1.785 \text{ \AA}$ . Given  $R = 109737 \text{ cm}^{-1}$ . 2
6. (a) Outline the main features of Raman spectrum. How is it explained on the basis of quantum theory? 2  
(b) Describe Franck–Condon principle in emission and absorption. Discuss its importance. 2

### SECTION – C (Compulsory)

7. Attempt any six parts :
- (a) What is the difference between fluorescence and phosphorescence?  
(b) State and differentiate Paschen–Back effect and Stark effect.
- (c) There are two electrons, each with  $l = 1$  and  $s = \frac{1}{2}$ . What are possible quantum number of  $J$ ?
- (d) Difference between Raman scattering and Rayleigh scattering.  
(e) Explain the meaning of Larmor precession and Larmor frequency.  
(f) Write a short note on Magnetic Resonance experiments.  
(g) Is  ${}^2D_{7/2}$  possible term? Why? 1×6=6