

## QUANTUM PHYSICS - III

Time : Three Hours]

[Maximum Marks : 75

**Note :** Attempt *five* questions in all. Select *one* question each from Section A, B, C, and D Q. No. 9 Section E is compulsory, attempt any *five* parts from it. Use of Non-programmable calculator is allowed.

### Section : A

1. (a) Derive Uncertainty principle, and give its two main applications. 6  
 (b) Find the ratio between the wavelengths of the de-Broglie waves for electrons in the second and third Bohr's orbits in hydrogen atom. 7  
 (c) Explain the meaning of well-behaved wave function. 2
2. State the prove Ehrenfest theorem. 15

### Section : B

3. (a) What is Harmonic oscillator ? Solve the Schrodinger equation for one-dimensional harmonic oscillator and obtain energy levels. 8  
 (b) Derive Time-independent Schrodinger wave equation. 7
4. Consider a particle is incident on a potential step of height  $V_0$  with energy  $E > V_0$ . Calculate the reflection and transmission coefficient. 15

### Section : C

5. (a) Describe Frank-Hertz experiment. What does it demonstrate ? 10  
 (b) What does the Stern-Gerlach experiment establish ? 5
6. Solve the radial part of the Schrodinger wave equation for hydrogen atom to obtain its energy levels. 15

### Section : D

7. (a) Distinguish between continuous and characteristic spectrum of X-rays, and explain their origin. 6  
 (b) What is Auger electron ? 3  
 (c) How the quantity and quality of X-rays can be controlled in a X-ray tube ? 3  
 (d) Why do all molecules not show rotational spectra ? 3
8. (a) Explain the origin of Stokes and Anti-stokes lines in Raman effect on quantum theory. 10  
 (b) State and explain Mosley's law. 5

### Section : E

9. Explain any *five* of the following in short : (Compulsory Questions)  
 (a) What are Diatomic and Polyatomic molecules ? Give examples.  
 (b) What are the various possible motions in a molecule ?  
 (c) What is meant by Normalization of a wave function ? Discuss.  
 (d) What are Orthogonal wave functions ?  
 (e) For hydrogen atom, why the solution of Schrodinger wave equation involves spherical polar coordinates ?  
 (f) What is normal Zeeman effect and anomalous Zeeman effect ?  
 (g) What is the condition for perfect transmission through a rectangular potential barrier ?  
 (h) What is Tunnel effect ? How does it explain Alpha-decay ? 5×3=15