



K23U 0240

Reg. No. : .....

Name : .....

VI Semester B.Sc. Degree (CBCSS – Supplementary) Examination, April 2023  
(2017 to 2018 Admissions)  
CORE COURSE IN PHYSICS  
6B13PHY: Quantum Mechanics

Time : 3 Hours

Max. Marks : 40

*Instruction : Write answers in English only.*

## SECTION – A

Answer **all**. Very short answer type. **Each** question carries **one** mark.

1. Write down any phenomenon that cannot be explained by classical physics.
2. Write down the expression for momentum operator.
3. What do you mean by stationary states ?
4. State the correspondence principle.

## SECTION – B

Answer **any seven**. Short answer type. **Each** question carries **two** marks.

5. What is Compton effect ? Give the formula for Compton shift.
6. Write down the expression for expectation value of any dynamical variable  $A$  whose operator is  $A_{op}$ .
7. Explain the idea of discrete spectrum and continuous spectrum of operators.
8. State any two postulates of quantum mechanics.
9. What do you mean by zero-point energy of a linear harmonic oscillator ? Write the expression for the zero-point energy of a harmonic oscillator.
10. State Wilson-Sommerfeld quantization rule.
11. What do you mean by group velocity and phase velocity ? Give their expressions.

P.T.O.

K23U 0240



12. State and explain Exclusion principle.
13. What do you mean by a free particle ? Write Schrodinger equation for a free particle.
14. What is the significance of Stern-Gerlach experiment ?

## SECTION – C

Answer **any four**. Short essay/problem type. **Each** question carries **three** marks.

15. Show that the energies of a harmonic oscillator is quantized.
16. State uncertainty principle. Write the position-momentum uncertainty relation and the energy-time uncertainty relation. Mention any one application of uncertainty principle.
17. Obtain time independent Schrodinger equation from Schrodinger time dependent equation.
18. A sample of certain element is placed in a 0.300T magnetic field and suitably excited. How far apart the Zeeman components of the 450 nm spectral line of this element ?
19. A 1 eV electron got trapped inside the surface of a metal. If the potential barrier is 4.0 eV and the width of the barrier is  $2\text{\AA}$ , calculate the probability of its transmission.
20. Briefly explain Stern-Gerlach experiment.

## SECTION – D

Answer **any two**. Long essay type. **Each** question carries **five** marks.

21. State the postulates of the Hydrogen atom. Obtain the expression for total energy of the electron and frequency of the spectral lines of Hydrogen atom.
22. Write down the Schrodinger equation of a particle in a square well potential with rigid wall. Obtain the eigen functions and energy eigen values.
23. Derive the Schrodinger equation of the Hydrogen atom in spherical polar coordinates. Write the equations for  $R$ ,  $\Theta$  and  $\Phi$  using separation of variables.
24. State and prove Ehrenfest's theorem.