

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.

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- 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 2Å, 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, Θ and Φ using separation of variables.
- 24. State and prove Ehrenfest's theorem.