

**BACHELOR OF SCIENCE (CBCS-2018 COURSE)**  
**T. Y. B. Sc. Sem-V : WINTER :- 2021**  
**SUBJECT: PHYSICS : QUANTUM MECHANICS**

Day : Friday  
Date 21-01-2022

W-18407-2021

Time : 02:00 PM-05:00 PM  
Max. Marks: 60

**N.B.**

- 1) All questions are **COMPULSORY**.
- 2) Figures to the **RIGHT** indicate **FULL** marks.

- Q 1.** Attempt any **Two** of the following. **(12)**
- (a) Obtain Schrödinger's time dependent equation.
  - (b) Discuss potential barrier qualitatively for  $E < V_0$ .
  - (c) Obtain the expression for group velocity.
- Q 2.** Attempt any **Two** of the following. **(12)**
- (a) Show that  $v_g = v_p - \lambda \frac{dv_p}{d\lambda}$ .
  - (b) Obtain equation of continuity. Give its physical interpretation.
  - (c) With the help of time independent Schrodinger's equation, obtain the energy eigen values and eigen functions for a particle in one-dimensional deep potential well.
- Q 3.** Attempt any **Two** of the following. **(12)**
- (a) What are matter waves? Obtain an expression for their wavelength.
  - (b) Obtain Schrodinger's time independent equation from time dependent equation.
  - (c) Show that the group velocity is equal to the particle velocity.
- Q 4.** Attempt any **Three** of the following. **(12)**
- (a) Find the de Broglie wavelength of 50 eV electron.
  - (b) Normalize the wave function  $\varphi(x) = e^{-\alpha x^2}$  in the range  $-\infty$  to  $+\infty$ .
  - (c) Plot a graph of wave function and probability density in case of simple harmonic oscillator.
  - (d) Prove that  $[L_z, y] = -i\hbar x$ .
- Q 5.** Attempt any **Four** of the following. **(12)**
- (a) Write different forms of uncertainty relations.
  - (b) Define the following terms,
    1. Operator
    2. Eigen value
    3. Expectation value
  - (c) State and explain tunneling effect.
  - (d) Show that,  $[x, p_x] = i\hbar$ .
  - (e) Define phase velocity and group velocity with expression.
  - (f) State any two phenomena where classical physics fails to explain the phenomena.

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