

**T.Y.B.SC. SEM – V (2014 COURSE) : SUMMER - 2018**  
**SUBJECT : PHYSICS: QUANTUM MECHANICS**

Day : **Thursday**  
Date : **12/04/2018**

Time : **03.00 PM TO 05.00 PM**  
Max. Marks : 40.

**S-2018-0737**

**N.B.:**

- 1) All questions are **COMPULSORY**.
- 2) Figures to the **RIGHT** indicate full marks.
- 3) Draw neat labeled diagrams **WHEREVER** necessary.

**Q.1** Attempt any **TWO** of the following: **(10)**

- a) Obtain expression for reflection and transmission probability for the particle in infinite potential well.
- b) Explain the Heisenberg's uncertainty principle using  $\gamma$ -ray microscope experiment.
- c) Obtain an expression for time dependent Schrodinger's wave equation.

**Q.2** Attempt any **TWO** of the following: **(10)**

- a) Explain the concept of eigenvalue and eigen function and what do you mean by expectation value.
- b) Define the term probability current density and obtain the equation of current density.
- c) Prove the Ehrenfest theorem  $d/dt \langle x \rangle = \langle P_x \rangle / m$ .

**Q.3** Attempt any **TWO** of the following: **(10)**

- a) Explain the various quantum mechanical operators with equations.
- b) Derive the expression for phase velocity and group velocity.
- c) Normalize the wave function  $\Psi_n = A \sin (n\pi x / a)$ ,  $n = 1, 2, 3, \dots$

**Q.4** Attempt any **FIVE** of the following: **(10)**

- a) Explain the dual nature of matter waves.
- b) Show that  $[A, [B, C]] + [B, [C, A]] + [C, [A, B]] = 0$ .
- c) Calculate the De- Broglie's wavelength of an electron produced by accelerating potential of 50V.  
(Given  $h = 6.063 \times 10^{-34}$  Js and  $m = 9.1 \times 10^{-31}$  kg).
- d) State two applications of Tunneling effect.
- e) What are the different characteristics of wave function?
- f) Prove that  $[L_x, L_y] = i\hbar L_z$ .
- g) Explain the various quantum numbers used in case of Hydrogen atom.

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