# T.Y.B.SC. SEM – V (2014 Course) : WINTER - 2018
## SUBJECT : QUANTUM MECHANICS

Day : Wednesday
Date : 10/10/2018

Time : 12.00 NOON TO 02.00 PM
Max. Marks : 40.

**W-2018-0830**

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**N.B.:**

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

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**Q.1** Attempt any **TWO** questions: **(10)**

**a)** Prove that Eigen values of the hermition operator are real.

**b)** State and prove Heisenberg's uncertainty principle using the single slit diffraction experiment.

**c)** Obtain an expression for the motion of one dimensional harmonic oscillator with energy diagram.

**Q.2** Attempt any **TWO** questions: **(10)**

**a)** Obtain the expression for radial part of Schrödinger wave equation for motion of electron in hydrogen atom, treating the nucleus to be at rest.

**b)** Obtain an expression for the Schrödinger's time independent wave equation.

**c)** Prove the Ehrenfest theorem $\frac{d\langle p_x \rangle}{dt} = -\left\langle \frac{dv}{dx} \right\rangle$.

**Q.3** Attempt any **TWO** questions: **(10)**

**a)** Obtain the expression for energy spectrum of free particle if motion of particle is in constant potential.

**b)** Using $V_p = \frac{\omega}{k}$, show that the group velocity $V_g = V_p - \lambda \frac{dV_p}{d\lambda}$.

**c)** Obtain an expression for the behavior of particle in a potential barrier and calculate the reflection (R) coefficient for it.

**Q.4** Attempt any **FIVE** questions: **(10)**

**a)** Explain the physical significance of wave function $\Psi$.

**b)** If the velocity of the ocean waves is $\sqrt{\frac{g\lambda}{2\pi}}$. Find the group velocity of ocean waves.

**c)** Write the Ladder operators.

**d)** Calculate the De- Broglie's wavelength of an electron which has kinetic energy equal to 40 eV (Given h = 6.063 x $10^{-34}$Js and m = 9.1 x $10^{-31}$kg).

**e)** Define the terms eigen function and eigenvalue.

**f)** Show that $[L^2, Lx] = 0$.

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