Third Year B.Sc. Examination
Oct – 2017
Physics : Paper – 301
(Classical Mechanics, Quantum Mechanics, Mathematical Physics)
Paper Code : 8937

Time : 2 Hours]   **[Total Marks : 75**

1 (a) Derive Lagrangian equation when frictional forces are present.   06
   (b) Define velocity dependent potential. Obtain Lagrangian equation for it.   09
   (c) Obtain equation of motion for particle moving under a central force.   04

OR

1 (a) State and prove mathematical statement of D'ALEMBERT's principle.   06
   (b) Derive equation of motion for bead , sliding on a uniform rotating wire in a force free space.   04
   (c) Define geodesic. Derive equation of great circle.   09

2 (a) Derive Hamilton's equation of motion.   07
   (b) Derive Hamilton's principle from Newton's equation.   05
   (c) Discuss Brachistochrone problem.   07

OR

2 (a) Derive Euler's equation and obtain Lagrangian equation from it.   09
   (b) State and prove Ehrenfest's theorem.   10

3 (a) Derive dimensionless Schrodinger equation for simple harmonic oscillator in one dimension. Discuss zero point energy.   06
   (b) Obtain equation of square of angular momentum operator.   07
   (c) Explain raising and lowering operator with its Eigen value relation.   06

OR

3 (a) Define abstract operator. Prove that $[a, a^\dagger] = 1$ 05
  (b) Prove that $[\widehat{L_z}, \widehat{L_x}] = i\hbar \widehat{L_y}$ 05
  (c) A particle is in the state described by the Eigen function Ψ of the operator $\hat{A}$ that doesn't depend upon time explicit. Show that corresponding Eigen value 'a' of the operator doesn't vary with time provided that the $\hat{A}$ commute with the Hamilton $\hat{H}$. 04
  (d) Prove that linear momentum is a self ad joint operator. 03
  (e) $[\hat{x}, \widehat{p_x}] = i\hbar$ 02

4 (a) Define ordinary and singular point. Discuss series solution method with an example. 08
  (b) Find out types of singularity for given examples.
  (1) $(1 + x)y'' + xy' - y = 0$, at $x = -1$ 02
  (2) $xy'' + (1 + 2x)y' + (1 + x)y = 0$, at $x = 0$ 02
  (3) $2xy'' + (4x + 1)y' + (2x + 1)y = 0$, at $x = 0$ 02
  (c) Derive gamma function. Prove that gamma $(m + 1) = m!$ 04

OR

4 (a) Obtain Laplacian operator and scale factor in spherical polar coordinate system. 07
  (b) Obtain Laplacian equation for spherical polar coordinate system. 11