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

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

1 (a) Write mathematical statement of D'ALEMBERT's principle. Derive Lagrangian equation from it , for conservative system. 08

(b) Derive generalized expression for kinetic energy in case of time dependent constraints. 05

(c) Explain constraints with example. 06

OR

1 (a) Define generalized potential. Obtain Lagrangian 'L' for a charged particle in an electro-magnetic field. 09

(b) Derive equation of cycloid. 07

(c) Using Lagrangian equation obtain equation of simple harmonic oscillator. 03

2 (a) State Hamilton's principle. Derive Lagrangian equation from it. 08

(b) Find equation of motion of one dimensional harmonic oscillator using Hamilton's principle. 03

(c) Explain fundamental postulates of Quantum mechanics. 08

OR

2 (a) Derive Euler's equation of motion. 09

(b) State and prove Ehrenfest's theorem. 10

3 (a) Define angular momentum. Obtain angular momentum operator component $\widehat{Lz}$ in spherical polar coordinate system. 09

(b) Obtain equation of square of angular momentum operator in spherical polar coordinate system. 07

(c) Show that $\widehat{Lz}$ is a self ad joint operator. 03

OR

3 (a) Derive dimensionless Schrodinger equation for simple harmonic oscillator in one dimension. 07

(b) Show that Eigen value of raising operator is increased by one in each operation. 04

(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) Define unitary operator.
prove that $|a|^2 = 1$, where a is Eigen value of unitary operator. 04

4 (a) Derive Helmholtz equation in Cartesian coordinate system. 07

(b) Find out types of singularity for given examples.

(1) $x(x + 1) + (3x + 1)y' + y = 0$ 02

(2) $xy'' - (1 - 2x)y' - (1 - x)y = 0$ 02

(3) $x^4y'' + 2x^3y' - y = 0$ 02

(c) Derive Helmholtz equation and time dependent equation for wave equation. 05

OR

4 (a) Define ordinary point. Discuss series solution method with an example. 06

(b) Derive Laplacian equation for spherical polar coordinate system. 12