Exam. Code : 103201
Subject Code : 1304

B.A./B.Sc. Semester–I

PHYSICS

Paper–A

(Mechanics)

Time Allowed—3 Hours]   [Maximum Marks—35

Note :— Section A is compulsory. Attempt **ONE** question from each of the Sections B, C, D and E.

SECTION–A

I. (i)   Prove that $\hat{r} \times \hat{\theta} = \hat{\phi}$.

   (ii) What is Conservative Force ? How is it related to potential energy ?

   (iii) Prove that angular momentum of a particle moving under central force is conserved.

   (iv) Is earth an inertial frame of reference ?

   (v)   At what point on the surface of the earth, will the plane of vibration of the Focault's pendulum rotate once a day ?

   (vi) What happens to the velocities and kinetic energies of the individual particles after an elastic collision in the centre of mass system ?

   (vii) How does a spherical top differs from a symmetric top ?   7×1=7

SECTION–B

II. (i)   Derive the expression for volume element in spherical polar coordinates.   5

   (ii) Define Solid Angle. Obtain an expression for solid angle subtended by the surface of a sphere at its centre.   2

OR

III. (i)   Starting from the expression for the velocity $\vec{v} = \dot{r}\hat{r} + r\dot{\theta}\hat{\theta} + r\dot{\phi}\sin\theta\,\hat{\phi}$ obtain an expression for the acceleration in spherical polar coordinates.   5

   (ii) Calculate the volume of a parallelopiped formed by the vectors $\vec{A} = 3\hat{i} - 4\hat{j} + 5\hat{k}$, $\vec{B} = 2\hat{i} + 3\hat{j} - \hat{k}$ and $\vec{C} = \hat{i} + 4\hat{j} + 3\hat{k}$.   2

SECTION–C

IV. Derive the equation of the orbit for an attractive inverse square law of force and also deduce its solution.   7

OR

V. Determine the turning points of a particle moving under central force. Show how the total energy is related to the shape of trajectory.   7

SECTION–D

VI. Discuss the effect of coriolis force on the free fall of a body from a height H above the surface of earth.   7

OR

VII. Discuss the variation of g with Latitude.   7

SECTION–E

VIII. What is differential and scattering cross section ? Obtain Rutherford's scattering formula.   7

OR

IX. Derive the Euler's equations of rotation of a rigid body about a fixed point.   7