Roll No. ..... **Total No. of Pages : 2**

PC 11441-NH

AS/2111
MECHANICS—I
Paper—A
Semester—I

Time Allowed : 3 Hours] [Maximum Marks : 30

Note :— The candidates are required to attempt ***two*** questions each from Sections A and B. Section C will be compulsory. Attempt any ***five*** from Section C.

SECTION—A

1. How can a system of two bodies interacting through a gravitational force be reduced to a one-body problem ? What would be the corresponding expressions for angular momentum and kinetic energy ? 5

2. What are Cartesian and spherical polar coordinates ? How are the coordinates of a point in two systems related to each other ? 5

3. (a) Write down Kepler's law of planetary motion. Prove Kepler's second law of motion.

   (b) If the average distance of mass from the sun is 1.52 times that of the earth from the sun. Find the period of revolution of mass around the sun. 3,2

4. Derive an expression for differential equation of orbit of particle moving under a central force. 5

SECTION—B

5. What are Galilean Transformations ? Show that the laws of conservation of energy and momentum are invariant under Galilean Transformations. 5

6. Derive an expression for effective force acting on a particle in uniformly rotating frame of reference. 5

7. Prove that the rotational invariance of space leads to conservation of angular momentum. 5

8. Show that two particles of equal mass move at right angles to each other after the elastic collision in lab system. 5

SECTION—C

9. Attempt any ***five*** questions :

   (a) What is the difference between inertial and non-inertial frames of reference ?

   (b) What is Coriolis force ? Explain its importance.

   (c) What is impact parameter and discuss its significance ?

   (d) What does translational and rotational invariance of space imply ?

   (e) What are the dimensions of the quantity $L^2/\mu r^2$?

   (f) Prove that the magnitude of velocity in spherical polar coordinates is given by $\vec{v} = \dot{r}\vec{r} + r\dot{\theta}\hat{\theta} + r\dot{\varphi}\sin\theta\,\hat{\varphi}$ where, symbols have their usual meaning.

   (g) When a particle moves under a central force, prove that its angular momentum is conserved. 5×2=10