

MECHANICS-I

AS/2110

S201/NH

SET-II

Time: 3 hrs

SECTION-A

M.M. 30

1. Define spherical polar coordinates. Why do we prefer spherical polar coordinate system? Derive an expression for the volume element in this system and find volume of the sphere. 5
2. What do you mean by conservative and non-conservative forces? Explain mathematically and with examples. 5
3. State Kepler's laws of planetary motion and use them to justify that force between sun and the planet obey inverse square law. 5
4. Define Turning Point. Show that the total energy is related to the shape of orbit. 5

SECTION - B

5. Given force is $\vec{F} = x^2\hat{i} + y^2\hat{j} + z^2\hat{k}$. Find out whether the force is conservative or not? 5
6. Show that total Kinetic energy of a system of two colliding particles in lab system is always greater than the Kinetic energy in the C.M. frame. 5
7. Derive an expression for Coriolis force acting on a particle moving in a vertical direction or along earth's radius. 5
8. (i) How faster than its present speed of rotation, earth should start rotating, so that the effective acceleration due to gravity at the equator will become zero? 2
(ii) Prove Covariance of Law of conservation of linear momentum under Galilean Transformation. 3

SECTION - C

9. Attempt any **five** questions: 5 x 2 = 10
 - (a) State the conditions under which the Coriolis force acting on the particle is zero.
 - (b) What are the conditions required for flatness of free space to hold good?
 - (c) Explain elastic and inelastic collisions.
 - (d) Is earth an inertial frame of reference? Explain.
 - (e) Obtain the equation of the orbit of a particle moving under an inverse square force field. Explain how the shape of the orbit depends upon the angular momentum and the energy.
 - (f) The spherical polar coordinates of a point are $(r, \theta, \phi) = (10, 30^\circ, 45^\circ)$; find the Cartesian coordinates of the same point.
 - (g) Define solid angle and its S.I. units. Find the solid angle subtended by a sphere at the centre.