2012
B.A./B.Sc. (General) First Semester
Physics
Paper – A: Mechanics – I

Time allowed: 3 Hours

Max. Marks: 44

NOTE: *Attempt five questions in all, including Question No. 7 (Unit-III) which is compulsory and selecting two questions each from Unit I - II. Use non- programmable scientific calculator is allowed.*

x-x-x

Unit-I

1 (a) Explain rotational invariance and discuss the conservation law which follows it.

(b) The potential energy of a particle under the action of force is:

$$U=2x^4+3x^2$$

Find the force acting on the particle.　　　　　　(7,2)

2 (a) Explain Centre of mass and show that the velocity of Centre of mass remains constant in the absence of external forces.

(b) The Cartesian coordinates of a point are (2,1,0). Find its spherical polar coordinates. (6,3)

3 (a) Define Solid angle and its S.I. units. Find Solid angle subtended by a sphere at its center.

(b) Show that the work done by a conservative force in taking the particle through the closed path is zero.　　　　　(6,3)

Unit-II

4(a) Show that the shape of trajectory of a particle moving under a repulsive central force and obeying inverse square law is a hyperbola.

(b) Calculate the force field associated with the potential energy $V=Ae^{\alpha(x+y+z)}$, where A and α are constants.　　　(6,3)

5(a) Find the relation between angles of scattering in C.M. & laboratory systems in two body elastic collisions.

(b) Two particles of masses m_1 and m_2 separated by a distance d are at rest initially. If they move towards each other under mutual interaction, where will they meet?　　(6,3)

6(a) Why do we reduce two body problem into one body problem by introducing the concept of reduced mass? Derive equation of motion of an equivalent one body problem.

(b) The eccentricity of earth's orbit around the sun is 0.017. Find the ratio of the maximum to the minimum speed of the earth in its orbit.　　(6,3)

P.T.O.

Unit-III

7. Attempt any **eight** parts. Each part carries **one** mark.

(a) Can a particle moving under an inverse square repulsive force trace a closed orbit? Give reason for your answer.

(b) What is space-time invariance principle?

(c) Show that spherical unit vectors $\hat{r}$ and $\hat{\theta}$ are orthogonal to each other.

(d) What is meant by homogeneity of time?

(e) What are the various forces in nature?

(f) Define impact parameter

(g) How many coordinates are needed to describe the motion of a particle under central force?

(h) Is the C.M. frame an inertial frame?

(i) What is the difference between scattering and reaction when two particles collide?

(i) What are impulse forces? (8X1=8)

x-x-x