Exam.Code:0001
Sub. Code: 17046

2115

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) What is a spherical polar coordinate system? Derive an expression for the acceleration of a body in a spherical coordinate system. **(5)**

(b)The motion of a particle is expressed by the equation $x = (5t-9), y = 2\cos(3t)$, $z = 2\sin(3t)$. Calculate velocity and acceleration of particle. **(4)**

2. (a) Derive an expression for area element and volume element in spherical polar coordinates. **(6)**

(b) Define Solid angle. Find the solid angle subtended by the sphere at its centre. **(3)**

3. (a) Prove that total kinetic energy of the system is the sum of the kinetic energy of the centre of mass of the system and the kinetic energy of motion of the system about centre of mass. **(6)**

(b) If the centre of mass of three particles of masses 2kg, 3kg and 4kg be at

(2, 2, 2), then where should a fourth particle of mass 5 kg be placed so that the combined centre of mass may be located at origin. **(3)**

UNIT - II

4. (a) Show that in the lab system, the particles of same mass will move at right angle to each other after a collision, if one of them were at rest before collision. **(6)**

(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. **(3)**

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5. (a) Derive the differential equation of motion of orbit under the central forces. (6)

(b) A particle of mass m moving in a circle of radius r under attractive inverse square force, $F = -k/r^2$, show that total energy of the particle at any point in the circle is $-k/2r$. (3)

6. (a) State and prove Kepler's Laws of planetary motion. (7)

(b) Prove that for an earth satellite, the ratio of its velocity at apogee to its velocity at perigee is equal to the inverse ratio of its distance from apogee and perigee. (2)

UNIT - III

7. Attempt any **Eight** parts. Each quesion carries **1** mark.

(a) Cartesian coordinates of a point are $(1, 0, \sqrt{3})$. Find corresponding spherical co-ordinates.

(b) What is the reduced mass of the system?

(c) In spherical polar coordinates, prove that $\hat{\theta} \times \hat{\phi} = \hat{r}$.

(d) Give two examples each of central and non-central forces.

(e) Does the speed of a satellite remain constant in a particular orbit? Explain.

(f) Mention the conditions under which the property of flatness of free space holds good.

(g) Define impact parameter giving its significance.

(h) What do you mean by dimensionality of space ?

(i) Is the area scalar or vector? Explain it.

(j) How does the distance of closest approach of an α-particle differ from the minimum distance of closest approach in Rutherford scattering? **8 × 1**