(i) Printed Pages :5] **Roll No. ....**

(ii) Questions :7]

Sub. Code : | 0 | 0 | 4 | 6 |

Exam. Code: | 0 | 0 | 0 | 1 |

B.A./B.Sc. (General) 1st Semester Examination

1127

PHYSICS

(Mechanics-I)

Paper : A

Time : 3 Hours] **[Max. Marks : 80**

Note :- (i) Attempt five questions in all, selecting two questions each from Unit-I and Unit-II.

(ii) Unit-III is compulsory.

(iii) Use of non-programmable scientific calculator is allowed.

(iv) Log tables may be asked for if needed.

Unit-I

1. (a) Define spherical polar co-ordinates. Derive an expression for volume element in this system and find volume of sphere. 6

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

2. (a) State homogeneity of flow of time. Prove that the law of conservation of energy is a consequence of homogeneity of time. 7

   (b) For what value of 'm' the given force $\vec{F} = (x^2 + y^2)\hat{i} + mxy\hat{j}$ is conservative. 2

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

   (b) If the centre of mass of three particles of masses 2kg, 3kg and 4 kg be at (2, 2, 2), then where should a fourth particle of mass 5 kg be placed so that combined centre of mass may be located at origin. 3

Unit-II

4. (a) Determine the turning points in the trajectory of a particle moving under a central force. Also discuss the relation of shape of trajectory with total energy. 6

(b) Mention various forces in nature. Also arrange them in the increasing order of their strength. 2

(c) Can a particle execute rotational motion in the absence of external torque. Explain. 1

5. (a) State Kepler's laws of planetary motion and use them to justify that force between sun and the planet obey inverse square law. 4

(b) Prove that for a satellite in earth orbit, the ratio of its velocity at apogee to that at preigee is equal to the inverse ratio of its distance from apogee and preigee. 3

(c) Show that for an elliptical orbit eccentricity 'E' is given by :

$$E = \frac{r_{max.} - r_{min.}}{r_{max.} + r_{min.}}$$ 2

6. (a) Find the relation between recoil angle in lab system and scattering angle in centre of mass system. 6

(b) A particle of mass 'm', moving with velocity $\vec{u}$, collides elastically with a particle of mass '6m' at rest. After collision, the incident pam'cle bounces back with same speed, while the target

moves in forward direction. Calculate:
(i) Velocity of both particles after collision in lab system (ii) Velocity of centre of mass. 3

Unit-III

7. Attempt any eight parts. Each part carries 1 mark.
   (a) Cartesian co-ordinates of a point are $(2\sqrt{2}, 2\sqrt{2}, 4\sqrt{3})$. Find corresponding spherical co-ordinates.

   (b) Find the direction of $\hat{\delta}$ for a particle moving in xy plane.

   (c) "Air friction increases the speed of satellite." Comment.

   (d) Give the significance of nuclear cross section.

   (e) Show that reduced mass of hydrogen atom is nearly equal to mass of electron.

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

   (g) Define impact parameter giving its significance.

   (h) What do you mean by dimensionality of space

   (i) The potential energy of a particle is given by

$U = (-2x^4 + 3x^2)$, where x is in meters. Find force acting on it when particle is located at (2, 0, 0).

(i) What is the advantage of studing a collision process in centre of mass system ? 8x1=8