

(i) Printed Pages : 3

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(ii) Questions : 7

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Exam. Code :

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B.A./B.Sc. (General) 1<sup>st</sup> Sem.

(2123)

## PHYSICS

Paper : A Mechanics-I

Time Allowed : Three Hours]

[Maximum Marks : 44

Note :— (1) Attempt **five** questions in all, selecting **two** from each Unit-I and Unit-II.

(2) Unit-III is compulsory.

(3) Use of Non-programmable Scientific Calculator is allowed.

### UNIT-I

1. (a) What are spherical polar coordinates ? Show that for a particle moving in space, the velocity in spherical polar coordinate system is expressed as :

$$\vec{v} = \dot{r} \hat{e}_r + r \dot{\theta} \hat{e}_\theta + r \dot{\phi} \sin \theta \hat{e}_\phi \quad 6$$

- (b) Define Solid angle. Show that the value of solid angle subtended by sphere at its centre is  $4\pi$  Steradian. 3

2. (a) State and prove the law of conservation of angular momentum for a system of n number of particles. 6



- (b) Locate the centre of mass of a system of three particles of masses 1kg, 2kg, and 3kg placed at corners of equilateral triangle of side 2m. 3

3. (a) Discuss the law of homogeneity of space. Show that it leads to the law of conservation of linear momentum. 5
- (b) Find whether force  $\vec{F} = yz \hat{i} + zx \hat{j} + xy \hat{k}$  is conservative or not. Where  $\hat{i}$ ,  $\hat{j}$  and  $\hat{k}$  are unit vectors. 4

## 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. 5
- (b) The central force of interaction can be written as

$$U(r) = \frac{-Ke^{-ar}}{r}, \text{ where } K \text{ and } a \text{ are constants and } U(r) \text{ is}$$

Yukawa potential. Find the value of force corresponding to given potential. 4

5. (a) Show that the angular momentum of a particle moving under central forces remains constant. 5
- (b) What is Rutherford scattering ? Obtain an expression for the scattering cross-section for it. 4

6. (a) Show that for elastic collisions in lab frame of reference  $\phi + \alpha = 90^\circ$ . 6

- (b) Neutron with mass  $1.67 \times 10^{-27}$  kg moving with velocity  $10^7$  m/s collides with a deuteron at rest and sticks to it. Calculate the velocity of the combination.

(Given, mass of deuteron is  $3.34 \times 10^{-27}$  Kg) 3



### UNIT-III

7. Attempt any **Eight** parts. Each part carries **1** mark.
- (a) What is the relation between Cartesian and spherical polar co-ordinates ?
  - (b) Write an expression for velocity of centre of mass.
  - (c) Define angular momentum.
  - (d) Define homogeneity of space.
  - (e) What is conservative force ?
  - (f) How many forces are there in nature ? Name them.
  - (g) What are central forces ?
  - (h) What is a difference between elastic and inelastic collision ?
  - (i) What do you mean by centre of mass ?
  - (j) State Kepler's Third Law.

$8 \times 1 = 8$