

## PHYSICS Paper-A

(Mechanics-II)

Time Allowed : 3 Hours

Max. Marks : 44

Note : Attempt five questions in all, selecting at least two each from Unit-I and Unit-II. Unit-III is compulsory. Use of log tables and non-programmable calculator is allowed.

### Unit - I

1. (a) What do you understand by fictitious force ? Show that the expression for  $\vec{F}_R$  in rotating frame is given by :

$$\vec{F}_R = \vec{F}_S - m\vec{\omega} \times (\vec{\omega} \times \vec{r}) - 2m(\vec{\omega} \times \vec{u}_R)$$

where the letters have their usual meanings. 6

- (b) Find the horizontal component of the Coriolis force acting on a body of mass 0.5 mg moving northward with a horizontal velocity of 100 m/s at 30°N latitude of earth. 3

2. (a) Describe Michelson-Morley experiment and explain physical significance of the results. 7

- (b) Calculate the time it will take the plane of oscillation of Foucault's pendulum to turn through 90° at a place where the latitude is 30°. 2

3. (a) Obtain Euler's equations for the motion of a rigid body about a fixed point. 6

- (b) What do you understand by precession and nutation in case of gyroscope ? 3

## Unit-II

4. (a) Starting from Lorentz's transformations for space co-ordinates derive the equations for transformations of velocity. Under what conditions do these equations reduce to Galilean Transformations for velocity? 6
- (b) The half life of a particle at rest is  $2.18 \times 10^{-8}$  sec. What will be its half life in a beam moving with a speed of  $0.8c$ ? 3
5. (a) Obtain the relativistic energy relation : 3
- $$E = \sqrt{p^2 c^2 + m_0^2 c^4} .$$
- (b) Explain relativistic Doppler effect. 3
- (c) What do you mean by Minkowski space? Why the time co-ordinate is multiplied by  $c$ ? 2+1
6. (a) Derive an expression for the relativistic increase in the mass of a body. 7
- (b) Calculate the decrease in mass of 1 gm of water at  $0^\circ\text{C}$ , when it turns into ice at  $0^\circ\text{C}$ . 2

## Unit-III

7. Attempt any eight parts, each part carries 1 mark :

- (a) What is twin paradox?
- (b) Is earth an inertial frame of reference?
- (c) How the Coriolis force affects the weather?
- (d) At what latitude will the plane of vibration of Foucault's pendulum not rotate at all?
- (e) Give two postulates of special theory of relativity.
- (f) Why length contraction is not observed in daily life?
- (g) "Inertia tensor is symmetric". Explain.
- (h) What are Galilean transformations?
- (i) How the rotation of earth affects the value of 'g'?
- (j) What do you mean by asymmetric top?  $8 \times 1 = 8$