

MAY 2015

**PHYSICS Paper-A**

(Mechanics-II)

Time Allowed : 3 Hours

Maximum Marks : 45

- Note: (i) Attempt five questions in all, selecting at least two questions each from UNIT-I and UNIT-II. Question No. 7 of UNIT-III is compulsory.  
(ii) Use of non-programmable calculator is allowed.

**UNIT-I**

1. (a) Derive Euler's equations for rotation of a rigid body about a fixed axis. 6  
(b) Three particles each of mass 'm' are placed at the points  $(2a, a, 0)$ ;  $(0, 2a, a)$  and  $(a, 0, 2a)$ . Find the principal moment of inertia of the system about z-axis. 3
2. (a) Derive an expression for the angular momentum of a rigid body about the Principal Axes ( $L_x, L_y, L_z$ ) and hence define Inertia Tensor. 6  
(b) A solid sphere of mass 50 g and radius 1 cm has a pivot pin of negligible dimensions fixed normally to its surface, when it spins like a top, it makes 14 revolutions/sec. Find out its precessional Angular-Velocity. 3
3. Discuss Michelson Morley experiment fully. What efforts were made to explain null results? 9

**UNIT-II**

4. (a) On the basis of Lorentz transformations, discuss :  
(i) Length contraction (ii) Time dilation. 6  
(b) Obtain the relation;  $E^2 = c^2(p^2 + m_0^2 c^2)$ , where symbols have their usual meanings. 3

5. Derive formula for relativistic variation of mass with velocity and discuss the result. 9
6. (a) What do you mean by relativistic Doppler effect and derive expression for longitudinal Doppler effect? 6
- (b) Find the volume of a cube moving with a speed of  $0.8 C$  parallel to one of its edges. 3

### UNIT-III

7. Attempt any six parts :
- (i) How instantaneous velocity and instantaneous position vectors of a particle are related when a rigid body rotates about a point?
  - (ii) What is a Gyroscope? Give one example.
  - (iii) What do you mean by a Symmetric and an Asymmetric top?
  - (iv) Explain space cone and body cone with the help of diagram.
  - (v) What are simultaneous events?
  - (vi) How are relativistically moving square appears to an observer at rest?
  - (vii) What is the energy liberated when 1 kg of mass is completely converted into energy?  $6 \times 1\frac{1}{2} = 9$