

AS/2051

MECHANICS-II

7/11/MH

Time: 3 Hrs.

Section A (Do Any Two)

M.M. 30

1. What are the characteristics of a rigid body? Explain the rotation of angular momentum vector about a fixed axis. 5
2. What do you understand by Galilean Transformations? Show that the laws of conservation of linear momentum and energy are invariant under Galilean Transformations. 5
3. Describe the aim and details of Michelson-Morley experiment. Also discuss the efforts made to explain the null result on the basis of other hypothesis. 5
4. Using equation for rotational motion of a rigid body, find the expression for time period of a compound pendulum. Also find the length of the equivalent simple pendulum having the same time period. (Assume that the angle to be very small through which the pendulum is displaced from equilibrium). 5

Section B (Do Any Two)

5. What are the properties and significance of Lorentz Transformations? Derive relations for relativistic addition of velocities. 5
6. Find an expression for increase in rest mass of a system of two bodies undergoing inelastic collision. Also show that this increase is due to the materialization of kinetic energy of the bodies before collision.
7. (a) Show that the three dimensional volume element $dx dy dz$ is not invariant under Lorentz Transformations, but the four dimensional volume element $dx dy dz dw$ is invariant under the transformations. 2
(b) Derive an expression for relativistic kinetic energy of a particle moving with velocity v and show that it reduces to classical kinetic energy for $v \ll c$. 3
8. What is Relativistic Doppler Effect? Derive expressions for Transverse and Longitudinal Doppler Effect. 5

Section C

9. Attempt any five out of the following: 2 x 5 = 10
 - i. Define the terms Precession and Gyroscope.
 - ii. Give physical significance of Moment of Inertia.
 - iii. What are inertial and non inertial frames of reference? Give examples.
 - iv. What do you mean by length contraction and time dilation?
 - v. If two events take place simultaneously at the same point in a given frame, under what conditions these events would be simultaneous in any other frame moving w.r.t the given frame with constant velocity. Explain.
 - vi. Explain the concept of Minkowski Space.
 - vii. Show that the rest mass of a photon is zero.