

October 2025
B.A./B.Sc.
First Semester
MAJOR – 1
PHYSICS
Course Code: PHM 1.11
(Mechanics)

Total Mark: 50

Pass Mark: 20

Time: 2 hours

I. Answer three questions, taking one from each unit.

UNIT-I

1. (a) What is a reference frame? Differentiate between inertial and non-inertial frames. 3
- (b) Derive Galilean transformation equations and use it to prove that velocity is not invariant under Galilean transformation. 6
- (c) A moving particle has co-ordinates $(6t + 3)$, $8t$, 5 in frame S at any time t . The frame S' is moving relative to S with a velocity $3\hat{i} + 4\hat{j}$ m/s. Find the co-ordinates and velocity of the particle in frame. 3
2. (a) Describe the motion of a rocket and obtain the expression of the thrust on a rocket. 6
- (b) Obtain the expression of acceleration in a uniformly rotating frame. 4
- (c) Show that the force $\vec{F} = (y^2 - x^2)\hat{i} + 2xy\hat{j}$ is conservative. 2

UNIT-II

3. (a) Obtain the relation between torque and angular momentum and prove that in absence of torque, angular velocity is constant. 4
- (b) Find the moment of inertia of a rectangular lamina about: 8
 - (i) An axis through its centre and parallel to one side
 - (ii) An axis passing through its centre and perpendicular to the plane

- (iii) An axis passing through the midpoint of one side and perpendicular to its plane
 - (iv) An axis passing through one of its corners and perpendicular to its plane
4. (a) Derive the differential equation of simple harmonic oscillator and find one of its solutions. 4
 - (b) What is forced oscillation? Write the differential equation of forced harmonic oscillator and obtain its solutions in the transient and steady state. 8

UNIT-III

5. (a) Find the gravitational potential and field due to a solid sphere at different possible points. 9
- (b) State Kepler's second law of planetary motion and prove it. 3
6. (a) Explain how mass varies with velocity in relativistic mechanics. 8
- (b) Discuss time dilation and apply to explain twin paradox. 4

II. Answer any two questions from the following.

7. Write the assumptions on which Poiseuille's equation is based and derive Poiseuille's equation for flow of liquid through a capillary tube. 7
8. (a) In case of a body rolling down an inclined plane, obtain the expression of acceleration of the rolling body and find the acceleration in case of a solid sphere. 5
- (b) Calculate the displacement to amplitude ratio for a S.H.M. when kinetic energy is 90% of total energy. 2
9. (a) Derive mass-energy equivalence relation. 5
- (b) At what speed is a particle moving if the mass is equal to three times its rest mass? 2