

AE-424

**B.Sc. (Part—I) Examination**

**PHYSICS**

**Paper—I**

**(Mechanics and Properties of Matter)**

Time—Three Hours]

[Maximum Marks—40

**Note :—** (1) All questions are compulsory.

(2) Draw neat and clean diagram wherever necessary.

**EITHER**

1. (a) Define :—
  - (i) Inertial frame
  - (ii) Non-inertial frame. 2
- (b) Obtain the components of velocity and acceleration in polar coordinates. 4
- (c) State and prove Kepler's third law of planetary motion. 2

**OR**

2. (p) Define central force and obtain the differential equation of motion of a particle under central force. 4
- (q) Distinguish between centripetal force and centrifugal force. 2

(r) Derive Newton's first law from second law. 2  
**EITHER**

3. (a) Define :—

(i) Gravitational field intensity

(ii) Gravitational potential at a point. 2

(b) Derive an equation for gravitational potential at a point outside a thin spherical shell. 4

(c) State and prove law of conservation of angular momentum. 2

**OR**

4. (p) State and prove the law of conservation of linear momentum for a system of N-particles. 4

(q) What are Elastic and Inelastic collision? Discuss the following cases in an elastic collision in one dimension :

(i) when colliding particles have the same mass.

(ii) when one of the colliding particle is initially at rest.

(iii) when particle at rest is much more massive than other.

(iv) when particle at rest is much lighter than the other. 4

**EITHER**

5. (a) Derive an equation for M.I. of a thin uniform rod

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(Contd.)

about a transverse axis passing through its centre of mass. 2

(b) State and prove perpendicular axis theorem. 3

(c) If radius of gyration of a thin circular disc about its diameter is 6 cm. Find its radius of gyration about a perpendicular tangent. 3

**OR**

6. (p) Derive an expression for M.I. of a thin uniform circular disc about an axis passing through its centre and perpendicular to its plane. 3

(q) Derive an equation for M.I. of a solid sphere about its diameter. 3

(r) If M.I. of a solid sphere about a diameter is  $\frac{2}{5}mr^2$ , find its M.I. about its tangent. 2

**EITHER**

7. (a) Define :—

(i) Cantilever

(ii) Neutral axis

(iii) Neutral surface. 3

(b) Derive an expression for bending moment of beam clamped at one end and loaded at the other end. Hence find the expression for depression of loaded end. 5

**OR**

8. (p) Explain the term :—

(i) Angle of twist

(ii) Angle of shear. 2

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(Contd.)

(q) Obtain an expression for a torque required for twisting a cylinder through angle  $\theta$ . 4

(r) Calculate the torque which must be applied to a wire of cast iron of length 2.5 m and diameter 2 mm in order to twist its one end through  $18^\circ$  the other end being fixed.

Modulus of rigidity of cast iron =  $5 \times 10^{10}$  N/m<sup>2</sup>.

2

**EITHER**

9. (a) Define streamline and turbulent flow. 2

(b) Derive an equation of continuity for steady flow of fluid. 2

(c) State and prove Bernoulli's theorem. 4

**OR**

10. (p) Define :—

(i) Surface tension

(ii) Surface energy

(iii) Angle of contact. 3

(q) Derive an expression of excess pressure inside a soap bubble. 2

(r) Find the amount of work done in blowing a soap bubble of surface tension 30 dyne/cm from its diameter of 2 cm to 4 cm. 3