Bsc Physic Sem - I

Paper 1 (Properties of Matter and Mechanics)

Question Bank

Unit 1

1. Obtain the general expression for depression of a beam fixed at one end and loaded at the other end. Hence obtain expression for depression of a beam of rectangular and circular cross-section.
2. Obtain an expression for time period of torsional pendulum.
3. Explain the terms : (i) Neutral surface (ii) Neutral axis (iii) Plane of bending.
4. What do you mean by angle of twist and angle of shear ? Obtain the relation between them
5. Define and explain the terms Bulk Modulus, Rigidity Modulus and Youngs Modulus of elasticity.
6. A metal bar of length 1 m and cross-section area 1 cm2 is clamped horizontally at one end and a weight of 1 kg is applied at the other end. Neglecting weight of the bar, calculate Youngs Modulus Y, if the depression of the loaded end is 4 cm.
7. Derive an expression for the volume strain in a homogeneous isotropic cube of length L when extensional forces are applied normal to the faces of the cube. Hence, obtain the relation between Y, K and s.
8. Derive an expression for the depression of a uniform beam supported at its ends and loaded in the middle.
9. Describe a tensional pendulum and show that oscillations of a tensional pendulum are simple harmonic.
10. Describe Maxwell's needle with the help of neat diagram.
11. Derive an expression for the volume strain in a homogeneous isotropic cube of length L when extensional forces are applied normal to the faces of the cube. Hence, obtain the relation between Y, K and s
12. What force is required to stretch a steel wire 1/2 sq. cm. in cross-section to double its length ? Given Y = 2 × 1011N/m2 .
13. Define Poisson's ratio. State its limiting value. Obtain an expression relating Young's modulus (Y), modulus of rigidity (h) and Poisson's ratio(s).
14. Obtain an expression for depression of cantilever.

15. The end of a rectangular cantilever depresses 10 mm under a certain load. Calculate the depression under the same load, for another cantilever of same material two times in length, two times in width and three times in thickness.
16. Define angle of twist. Derive the relation between angle of twist (q) and angle of shear (f).
17. Show that modulus of rigidity for torsion pendulum is 2 4 1 2 2 o (T T)r 8 I - p h = l where I o - M.I. of auxiliary body.
18. Derive the relation for strain energy in stretching a wire.
19. What is angle of twist and angle of shear ? Obtain an expression for torque required to twist a cylinder at its free end.
20. For homogeneous isotropic medium, show that Y = 3K(1 – 2s) where symbols have their usual meaning
21. What force is required to stretch a steel wire of cross-section of 0.5 cm2 to double its length ? (Given : Y = 2×1011 N/m2)
22. Describe how the modulus of rigidity of the material of a wire can be determined by using torsional pendulum
23. What is external bending moment ? Obtain an expression for external bending moment of a beam fixed at one end and loaded at the other
24. Define elasticity. Explain graphically, the behaviour of a wire under increasing load.

Unit 2

1. State and prove Bernoulli's theorem.
2. In a horizontal tube 4 km long 8 cm diameter, a water flows at the rate 20 lit/sec against viscous resistance. If the viscosity of water is 0.01 CGS units; calculate pressure required to maintain the flow.
3. Define Terminal Velocity Obtain an expression for terminal velocity of small sphere of radius r, through the liquid of viscosity h and density s. State the factor on which terminal velocity of the sphere depends.
4. What is Newton's law of viscous force ? Obtain an expression for coefficient of viscosity. State its unit and dimensions.
5. What do you mean by Reynold's number ? Give its physical significance.
6. State the Stoke's Law of viscosity and prove it by method of dimensions.
7. Distinguish between Streamline flow and Turbulent flow

8. Eight drops of water of the same size are falling through air with terminal velocity of 10 m/s. If the eight drops combined to form a single drop, what will be the new terminal velocity ?
9. Differentiate between streamline and turbulent flow of a liquid
10. Define co-efficient of viscosity. Obtain its units and dimensions.
11. Explain the significance of Reynold's number.
12. Explain the lift of an aeroplane on the basis of Bernoulli's principle.
13. Derive Poiseuille's formula for the rate of steady flow of liquid through a capillary tube of circular cross-section. State the assumptions made.
14. Obtain an expression for critical velocity of the liquid using dimensional analysis.
15. State and prove Bernoulli's Theorem
16. Assuming the expression for the velocity of cylindrical layer of liquid at a distance x from the axis of tube, obtain Poiseuille's Formula
17. Distinguish between streamline flow and turbulent flow
18. What is terminal velocity ? Explain. State and prove Stoke's law of viscosity. How can it be used to determine the terminal velocity of a body in a viscous fluid ?
19. What is Newton's law of viscous force ? Obtain an expression for coefficient of viscosity. State its units and dimensions
20. Deduce an expression for the velocity of a liquid flowing through a uniform capillary tube of circular cross-section.
21. State Bernoulli's theorem. Explain the lifting of an aeroplane.
22. What is viscosity of liquid ? How critical velocity of liquid makes a difference of streamline and turbulent flow ?

Unit 3

1. What is surface energy ? Show that the surface tension of a liquid is equal to its surface energy per unit area.
2. Calculate the height to which a liquid will rise in a capillary tube of radius 0.2 mm when surface tension of liquid is 20 × 10–3 N/m and density 800 kg/m3 . (Given : Angle of contact = 0 degree)
3. What are inertial and non-inertial frames of reference ? Give its examples.
4. State Newton's Laws of motion. Obtain Newton's first law from Newton's Second law
5. What is Coriolis force ? State any three applications of Coriolis force.
6. A bullet of mass 500 g is fired from a gun at an angle of 30°N axis with velocity 500 m/s towards north. Calculate the Coriolis force acting on the bullet.

7. Derive the equations for velocity and acceleration of a particle moving along curve path in two dimensional Cartesian coordinate system.
8. Explain the molecular theory of surface tension.
9. What is surface energy ? Derive the relation between surface tension and surface energy
10. Why the surface of water is concave and surface of mercury convex, when it is kept in contact with solid?
11. State Newton's laws of motion. Discuss the limitations of Newton's Laws of motion.
12. A particle moving in a plane has position coordinates x = 3 and y = 4. Components of its speed are x& = 5m/sec and y& = 8m /sec at some instant. Find the radial and transverse components of its speed in the form of polar coordinates r and q.
13. State Newton's Laws of Motion. Derive an expression for components of velocity in Cartesian co-ordinate system
14. What is Coriolis Force ? Obtain the expression for it.
15. Find the Cartesian co-ordinates corresponding to the polar coordinates (–1, 5p/4).
16. What is Surface Energy ? Show that surface energy per unit is numerically equal to surface tension
17. Derive the expression for surface tension of liquid using capillary rise method.
18. What is meant by Wetting ? State the applications of wetting or not wetting surface area.
19. Calculate the work done in blowing a soap-bubble of radius 10 cm. The surface tension of the soap solution is 30 dyne/cm.
20. Obtain equations for components of velocity and acceleration in spherical coordinate system.
21. What is surface energy ? Show that the surface tension of a liquid is equal to its surface energy per unit area.
22. Explain the Quincke's method for determination of surface tension of a liquid.
23. Obtain an expressions for the radial and transverse components of velocity and acceleration of a particle moving along a curve in a plane.
24. What are inertial and non-inertial frames of reference ? Give its examples
25. A point is moving in a plane has co-ordinates x = 3, y = 4 and has components of speed x& = 5m/sec, y& = 8 m/sec at some instant of time. Find the components of speed in polar co-ordinates r, q along directions q) rˆ and .

Unit 4

1. What is elastic and inelastic collision ? Discuss the phenomenon of collision in one dimension between two particles when collision is perfectly elastic when : (i) Colliding particles have same mass (ii) One of the colliding particle is initially at rest
2. Derive moment of inertia of solid sphere about its diameter.
3. State and prove theorem of perpendicular axis of moment of inertia
4. State and prove the law of conservation of angular momentum.
5. Define centre of mass. Obtain the equation of centre of mass.
6. What is a rocket ? Describe the principle of a rocket. Establish the following relation for a rocket: V = Vo + Ve loge Mo /M.
7. State and prove the theorem of parallel axes.
8. State and prove the law of conservation of energy for a single particle.
9. Discuss the phenomenon of collision in one dimension between two particles when the collision is in elastic.
10. Obtain an expression for the moment of inertia of a solid cylinder about an axis passing through its centre and perpendicular to its own axis.
11. A hollow sphere of steel has inner and outer radii equal to 5 cm and 12 cm respectively. Calculate its moment of inertia about a diameter. Density of steel is 7.8 × 103 kg/m3 .
12. What is a Rocket ? Obtain an expression for the final velocity achieved by the rocket of initial Mass (Mo) and final mass (M).
13. State and prove the theorem of parallel axis.
14. Find the moment of inertia of earth assuming that it is a sphere of radius 6400 km and uniform density 5520 kg/m3 about an axis of rotation passing through its centre.
15. State law of conservation of linear momentum. Explain the recoil of the gun using conservation of linear momentum. 2
16. Define Radius of Gyration. Explain its physical significance.
17. Two object of mass m1 = 2g and m2 = 5g posses velocity u1 = 10 cm/s and u2 = 5 cm/s. They suffer an elastic collision. Find out the velocity of both the objects after collision.
18. Define centre of mass. Obtain the equation of motion of centre of mass. Show that when no external force acts on a body the acceleration of centre of mass is zero and its velocity is constant.
19. Derive an expression for moment of inertia of solid cylinder about an axis passing through its centre and perpendicular to its axis
20. Calculate radius of gyration of solid cylinder at mass 20 kg and radius 40 cm about an axis passing through its centre along its length.

21. Distinguish between elastic collision and inelastic collision.
22. State and prove the law of conservation of energy.