**Bachelor of Science (B.Sc.) (Semester–I) Examination**

**101 : PHYSICS**

**(Properties of Matter and Mechanics)**

**Paper–I**

Time—Three Hours] [Maximum Marks—50

**Note :—** (1) All questions are compulsory.
(2) Draw neat diagram wherever necessary.

**EITHER**

1. (A) 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. 5

(B) (a) Obtain the relation between three modulii of elasticity.

(b) Calculate the bulk modulus of elasticity of brass. Given that for brass, $\gamma = 10 \times 10^{10}$ N/m$^2$ and $\eta = 3.7 \times 10^{10}$ N/m$^2$. 3+2

**OR**

(C) Explain the term :

(i) External Bending Moment

(ii) Internal Bending Moment. 2½

(D) Obtain an expression for the torque required to twist a cylinder. 2½

(E) Assuming the relation between $\gamma$, k and $\sigma$ and that between $\gamma$, $\eta$ and $\sigma$; obtain the maximum and minimum theoretical values of Poisson's ratio, $\sigma$. 2½

(F) In an experiment the diameter of the rod was 1.26 cms and the distance between the knife edges 70 cms. On putting a load of 900 gms at the middle point, the depression was 0.025 cm. Calculate the Young's modulus of the substance.

(Given : $g = 981$ cm/sec$^2$). 2½

**EITHER**

2. (A) State and prove Bernoulli's theorem. 5

(B) (i) Derive equation of continuity for streamline flow. 3

(ii) Determine the horizontal force required to move a metal plate of area 0.02 m$^2$ with a velocity 4.5 cm/s, when it rests horizontally on a layer of oil $1.5 \times 10^{-3}$ m thick.

Given : Coefficient of viscosity = 2 NS/m$^2$. 2

OR

(C) In a horizontal tube 4 kms long and 8 cms diameter, water flows at the rate of 20 lit/sec against the viscous resistance. If the viscosity of water is 0.01 in CGS units, calculate the pressure required to maintain the flow. 2½

(D) Prove the Stoke's law by the method of dimension. 2½

(E) Define viscosity. Obtain an expression for coefficient of viscosity. 2½

(F) Distinguish between Streamline flow and Turbulent flow. 2½

**EITHER**

3. (A) Define surface tension. Give its examples. What are the applications of surface tension ? 5

(B) (i) What do you mean by surface energy ? Derive the relation between surface tension and surface energy. 3

(ii) Calculate the potential energy of spherical mercury drop of radius 0.01 m due to surface tension. The S.T. of mercury is 0.46 N/m. 2

**OR**

(C) State and prove the law of conservation of linear momentum. 2½

(D) State Newton's laws of motion. Obtain Newton's first law from Newton's second law. 2½

(E) What is coriolis force ? State any three applications of coriolis force. 2½

(F) Find the magnitude and direction of coriolis force that acts on a 800 kg van running to north at 144 km/hr at a place where latitude is 30° N. 2½

**EITHER**

4. (A) State the principle of working of Rocket. Give the theory of single stage rocket. 5

(B) (i) Derive an expression for the velocity of the particles in perfectly elastic collision in one dimension. 3

(ii) A cart A of mass 50 kg moving at a speed of 20 km/h hits a lighter cart B of mass 20 kg moving towards it at a speed of 10 km/h. The two carts cling to each other, find the speed of the combined mass after collision. 2

**OR**

(C) Define moment of inertia. State the physical significance of M.I. 2½

(D) Derive an expression for moment of inertia of a solid cylinder about a perpendicular axis passing through its centre. 2½

(E) Obtain the relation between :

(i) Angular momentum and moment of inertia

(ii) Torque and moment of inertia. 2½

(F) A solid sphere of mass 200 gm and radius 5 cm is rolling on a horizontal surface in a straight line with a velocity 2 m/s. Calculate total energy. 2½

5. Attempt any *ten* :—

(i) A wire of radius 1 mm is stretched by applying load of 10 kg. Find stress in the wire, given $g = 9.8\ m/s^2$.

(ii) Define angle of twist and angle of shear.

(iii) What is neutral surface and neutral axis of a beam ?

(iv) Define the kinetic viscosity.

(v) What do you mean by Reynold's number ?

(vi) Define terminal velocity.

(vii) What will the value of excess pressure inside a soap bubble; when surface tension T is 0.03 N/m and radius R is 7.5 mm.

(viii) What is wetting in surface tension ?

(ix) Write any two examples of capillary rise phenomenon.

(x) Define radius of gyration. Give its unit.

(xi) Give any two differences between elastic and inelastic collision.

(xii) Two particles of masses 100 and 300 gm, have positions $2\,i + 5\,j + 13\,k$ and $-6\,i + 4\,j - 2\,k$ cm respectively at a given time. Find the instantaneous position of the centre of mass from the origin.

(1×10=10)