NRT/KS/19/2010

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

PHYSICS (PROPERTIES OF MATTER AND MECHANICS)

Optional Paper–1

Time : 3 Hours] [Maximum Marks : 50

N.B. :— (1) All questions are compulsory.

(2) Draw neat diagrams wherever necessary.

EITHER

1. (A) Define Poisson's ratio and give limiting values of Poisson's ratio. If Y, K and σ represents Young's modulus, Bulk modulus and Poisson's ratio, then, show that, $Y = 3K(1-2\sigma)$. 5

(B) (i) Obtain an expression for time period of torsional pendulum. 3

(ii) A wire of length 1m and diameter 1 mm is damped at one end. Calculate the torque required to twist other end by 90^{o}. If modulus of rigidity of material of wire is 2.8×10^{10} N/m^2. 2

OR

(C) Derive an expression for work done in stretching a wire. 2½

(D) Show that for a homogeneous isotropic medium, $Y = 2\eta(1 + \sigma)$, where constants have their usual meaning. 2½

(E) Derive an expression for the bending of a beam supported at two ends and loaded in the middle. 2½

(F) A beam of square cross section $1cm^2$ and 1m long is clamped horizontally at one end. When the load of 1kg is applied to the free end, the depression of the free end is 4×10^{-2}m. Calculate Young's modulus of the material of the cantiliver. ($g = 9.8m/s^2$) 2½

EITHER

2. (A) State and prove the Stoke's law by method of dimensions. Deduce an expression for terminal velocity of a spherical body, through a viscous medium. 5

(B) (i) State and prove Bernoulli's Theorem. 3

(ii) Calculate the mass of water per second initially flowing out of the hole. If the depth of water in an open tank is 2.5m and a small hole of cross-section $3cm^2$ is made at the bottom of tank. ($\rho = 1000$ kg/m^3) 2

OR

(C) What is the effect of temperature on coefficient of viscosity ? Explain. 2½

(D) State Newton's law of viscous force. Obtain an expression for coefficient of viscosity. State its unit. 2½

(E) Distinguish between streamline and turbulent flow. 2½

(F) Calculate the mass of water flowing in 10 minutes through a tube 0.1 cm in diameter and 40cm long under a constant pressure head of 20cm of water. The coefficient of viscosity of water at room temperature is 8.2×10^{-3} poise. 2½

EITHER

3. (A) Define surface tension. State its units and dimensions. Derive an expression for the height of liquid column in a capillary tube of radius 'r'. 5

(B) (i) Define Coriolis force. Discuss the applications of the Coriolis force. 3

(ii) Find the polar coordinates corresponding to the following Cartesian coordinates :

(a) (1, 0)

(b) (1, 1) 2

OR

(C) Distinguish between inertial and non-inertial frame of reference with example. 2½

(D) State Newton's law's of motion. Derive an expression for Newton's third law from the second law. 2½

(E) What is surface energy ? Show that the surface tension of a liquid is equal to its surface energy per unit area. 2½

(F) 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/m^3. (assuming angle of contact 0^o) 2½

EITHER

4. (A) What is elastic and inelastic collision ? Derive the equations for final velocities of two particles when the collision between them is perfectly one dimensional elastic. 5

(B) (i) Deduce an expression for the moment of inertia of solid cylinder about an axis passing through its centre and perpendicular to its length. 3

(ii) Mass of earth is 6×10^{24} kg and its radius is 6400 km. Find the moment of Inertia of earth about its axis of rotation. 2

OR

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

(D) Explain the need of multistage rocket to launch the satellite. 2½

(E) Explain the term moment of inertia and give its physical significance. 2½

(F) Calculate the radius of gyration of solid sphere rotating about its diameter if its radius is 5.0 cm. 2½

5. Attempt any **ten** questions :

(i) Define angle of twist

(ii) Define compressibility.

(iii) Calculate the bulk modulus of brass. ($Y = 10 \times 10^{10} N/m^2$ and $\eta = 3.7 \times 10^{10} N/m^2$)

(iv) What is Critical Velocity ?

(v) What is Reynold's number ?

(vi) The critical velocity of fluid flows in capillary tube of radius 0.02 mm is 4 cm/s, what will be the critical velocity of the same fluid in capillary of radius 0.01 mm ?

(vii) State any two applications of Newton's laws of motion.

(viii) Mention conditions for the validity of the Stoke's law.

(ix) Calculate the work done in blowing a soap bubble of radius 10cm and surface tension 30 dyne/cm.

(x) Define centre of mass.

(xi) What do you mean by radius of gyration ?

(xii) The position vectors of two particles of masses 1kg and 3kg at any instant are $\left(2\hat{i} + 5\hat{j} + 13\hat{k}\right)$ m and $\left(-6\hat{i} + 4\hat{j} - 2\hat{k}\right)$ m respectively. Calculate the position vector of centre of mass at that instant. 1×10=10