2020

PHYSICS (Honours)

Paper : PHYH - DC-2T

[CBCS]

Full Marks : 25 Time : Two Hours

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

1. Answer any *five* questions : 2×5=10

(a) What do you mean by non-inertial frames ? Give an example of such frame.

(b) A particle moves in a field of force given by $F_x = yz(1-2xyz)$ and $F_z = xy(1-2xyz)$. Verify that the force is conservative.

(c) The trajectory of a particle of unit mass is given by the radius vector, $\vec{r} = \hat{l}\alpha\cos\omega t + \hat{j}b\sin\omega t$, where a, b are constants. Calculate angular momentum of the particle about the origin. Show that it is constant and along $\hat{k}$.

(d) Show that the rocket speed is twice the exhaust speed when $\frac{M_0}{M} = e^2$

(e) Explain why a hollow cylinder is stronger than a solid cylinder of the same length, mass and material.

(f) Calculate the Poisson's ratio for silver. Given Young's modulus for the silver is 7.25×10^{10} N/m^2 and bulk modulus is 11×10^{10} N/m^2.

(g) State Kepler's laws of planetary motion.

2. Answer any *three* questions : 5×3=15

(a) Prove that the kinetic energy of rotation of a rigid body can be expressed in the form $T = \frac{1}{2} I_{ij} \omega_i \omega_j$ with the convention that repeated indices are summed over x, y, z and show that relative to any point in the rigid body it can be simplified to the form $T = \frac{1}{2}\left(I_1\omega_1^2 + I_2\omega_2^2 + I_3\omega_3^2\right)$. 4+1=5

(b) Derive an expression for the equation of continuity of an ideal fluid of density ρ. What is the form of this equation, when the fluid is incompressible ? 4+1=5

(c) (i) If a body falls freely in the earth's gravitational field form infinity, show that it attains the same velocity as that attained by a free fall from a height above the earth equal to the radius R under a constant acceleration of gravity 'g'.

(ii) The differential equation of the orbit of a particle of mass m under a central force is given by $\frac{d^2u}{d\theta^2} + u = -\frac{m}{L^2u^2} f\left(\frac{1}{u}\right)$ where $u = \frac{1}{r}$, $L =$ constant, other notations have usual significance. Use the above relation and consider the following : A particle moves in a central orbit described by $r = e^{(-\alpha\theta)}, \alpha$ is a positive constant, with force centre at O. Find the nature of the force as a function of r. 3+2=5

(d) With necessary assumptions, deduce Poiseuille's formula for the viscous flow of a liquid in a capillary tube. 5

(e) Find the depression of a cantilever beam of uniform cross-section and weight W, when loaded at the free end by a weight W_0. 5