

**2024**

Time :As in Programme

Full Marks : 100

*The figures in the right-hand margin indicate marks.*

*Answer all questions.*

**PART-I**

1. Answer all the following Questions. 1x10
- a. The direction of coriolis force is radially \_\_\_\_\_. (inword/ outword/normal)
  - b. Does the moment of Inertia is a scalar quantity ? (yes/ no/uncertain)
  - c. The viscosity of liquid \_\_\_\_\_ with rise of temperature.
  - d. The gravitational field intensity inside spherical shell is \_\_\_\_\_.
  - e. The orbital velocity of geostationary satellite is \_\_\_\_\_.
  - f. The damping force is directly proportional to \_\_\_\_\_ and oppositely directed.
  - g. Does the poiseullie's formula valid during turbulent fluid flow ? (yes / no/uncertain)
  - h. The compressibility is reciprocal of \_\_\_\_\_ of fluids.
  - i. the kinetic energy of a particle moving with relativistic velocity is \_\_\_\_\_.

(Turn Over)

- j. Michelson Morley Experiment in 1887 were performed to detect the relative motion between the earth and \_\_\_\_\_.

### PART-II

2. Answer the following in 50 words each. 2x9
- a. State Routh Rule on moment of Inertia.
  - b. Distinguish between centre of mass Frame and Laboratory frame.
  - c. State and prove parallel axes theorem.
  - d. Distinguish between streamline and turbulent flow.
  - e. When a particle execute SHM along a straight line has velocity  $v_1$  and  $v_2$  at positions  $x_1$  and  $x_2$  respectively. Obtain the frequency of oscillation.
  - f. With what velocity a particle should move so that its mass appears to increase by 10% than of its rest mass.
  - g. Prove that  $E^2 = p^2c^2 + m_0^2c^4$  in relativistic mechanics.
  - h. Notes on centrifugal force.
  - i. Define quality factor and write its significance.

### PART-III

3. Answer any eight questions of the followings in 250 words each. 5x8
- a. State and prove the conservation of angular momentum for a system of particles.
  - b. Establish the Euler's equations of motion for a rigid body.
  - c. Derive the twisting torque expression for a solid cylinder.
  - d. Obtain the velocity of gravity waves and ripples.

- e. Show that two body central force problem is equivalent to one body problem.
- f. Write a note on global positioning system (GPS).
- g. Discuss about relativistic transformation of velocity.
- h. Using Lorentz transformation show that  $x^2+y^2+z^2=c^2t^2$  is invariant.
- i. Establish the laws of physics in uniformly rotating frame.
- j. Establish the theory of Kater's Pendulum.

#### PART-IV

Answer any four of the following in 800 words each. 8x4

4. Obtain the moment of Inertia of a Fly wheel.
5. Define various elastic constants and establish relations between them.
6. Under Central force motion deduce Kepler's Laws of Planetary motion.
7. Write special theory of relativity. Deduce Lorentz transformation equations.
8. Deduce expression for gravitational potential and field due to a solid sphere at various locations.

