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**1 SEM TDC PHYH (CBCS) C 2**



**2022**

( Nov/Dec )

PHYSICS

( Core )

Paper : C–2

**( Mechanics )**

*Full Marks* : 53

*Pass Marks* : 21

*Time* : 3 hours

*The figures in the margin indicate full marks for the questions*

**1.** Choose the correct answer from the following : 1×5=5

*(a)* The curl for conservative force is

*(i)* one

*(ii)* zero

*(iii)* infinite

*(iv)* None of the above

(b) The moment of inertia of a body rotating about an axis is

(i) $\frac{2K}{\omega^2}$

(ii) $\frac{K}{\omega^2}$

(iii) $\frac{MK}{\omega^2}$

(iv) $\frac{\omega^2}{2K}$

(c) The couple required to twist a rod through $\varphi$ radians is

(i) $\frac{\pi\eta r^4}{2l}$

(ii) $\frac{\pi\eta^2 r^2}{2}$

(iii) $\frac{\pi\eta^2 r^2}{4l}$

(iv) $\frac{\pi\eta}{2l}$



( Continued )



(d) The velocity profile of a liquid flowing through a capillary tube is

(i) straight line

(ii) parabolic

(iii) hyperbolic

(iv) circular arc

(e) The phase difference between driving force and velocity of forced oscillator is

(i) $\varphi$

(ii) $\frac{\pi}{2}+\varphi$

(iii) $\varphi-\frac{\pi}{2}$

(iv) $\frac{\pi}{2}-\varphi$

**2.** (a) What is meant by inertial frame of reference? Can you regard earth as an inertial frame? Explain. 1+1=2

( Turn Over )

(b) Establish the relation between torque and angular momentum. 2

*Or*

Derive the law of conservation of linear momentum from Newton's laws of motion.

(c) Calculate the angular momentum and rotational KE of earth about its own axis. The mass of earth is $6\times10^{24}$ kg and the radius is $6\cdot4\times10^{3}$ km. 2

(d) Calculate Poisson's ratio for silver. Given Young's modulus $=7\cdot25\times10^{10}\ N/m^2$ and Bulk modulus $=11\times10^{10}\ N/m^2$. 2

(e) Why was the apparatus of Michelson-Morley experiment rotated through 90°? 2

3. What is Galilean transformation? Derive Galilean transformation equation for two inertial frames. 1+3=4





4. (a) Explain the concept of potential energy. Show that potential energy may be defined as a function of position whose negative gradient gives the intrinsic force. 1+2=3

*Or*

A constant force of 5 N acts for 10 sec on a body whose mass is 2 kg. The body was initially at rest. Calculate the work done by the force and the final kinetic energy. 1½+1½=3

(b) Show that in a head on collision between two particles the transfer of energy is maximum when their mass ratio is unity. 3

(c) Define moment of inertia and radius of gyration of a body rotating about an axis, hence explain their physical meaning. 1½+1½=3

**5.** *(a)* Deduce an expression for the gravitational potential and attraction due to this spherical shell at a point outside the shell. 4

*(b)* Show how by introducing the concept of reduced mass, a two-body problem under central forces can be reduced to a one-body problem. 3

*Or*

When a particle moves under central force, prove that the angular momentum of a particle is constant.

*(c)* Mention the limitations of Poiseuille's formula. 2

**6.** *(a)* A particle is oscillating under a damping force. Show that power dissipation is $P = \frac{E}{\tau}$, where $E$ is average energy and $\tau$ is relaxation time. 4

*Or*

What is sharpness of resonance? Explain the effect of damping on sharpness and resonance. 1+3=4



( Continued )



*(b)* A particle executes simple harmonically as

$$y = 0 \cdot 1 \sin (100 \pi t + \frac{\pi}{4}) \text{ m}$$

Find maximum amplitude and angular frequency of oscillation. 2

**7.** Discuss the effects of the centrifugal force due to earth rotation. 5

**8.** What is relativistic Doppler effect? Derive relation for longitudinal Doppler effect. 1+4=5

*Or*

Derive transformation formulae for relativistic momentum. 5

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