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1 SEM TDC PHYH (CBCS) C 2

2024

(November)

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 option from the following : 1×5=5

(a) A time-dependent linear momentum is given by $p = (2t^2 + 4t + 2)$ kg m / s. The instantaneous force acting on the particle is

(i) $(4t^2 + 4)$ N

(ii) $(2t^2 + 4)$ N

(iii) $(4t^2 + 4t)$ N

(iv) $(4t + 4)$ N

(b) If the mechanical energy of a particle is conserved, then the particle is acted upon by a

(i) non-conservative force

(ii) friction

(iii) conservative force

(iv) drag force

(c) Weightlessness experienced while orbiting the earth in spaceship is the result of

(i) inertia

(ii) acceleration

(iii) zero gravity

(iv) free fall towards the earth

(d) Velocity of a body moving with simple harmonic motion is

(i) $\omega\sqrt{a^2+y^2}$

(ii) $\omega\sqrt{a^2-y^2}$

(iii) $\omega^2\sqrt{a^2-y^2}$

(iv) ωa

(e) Coriolis force acting on a particle having velocity in a rotating frame of reference is

(i) $2m\frac{\omega}{v}$

(ii) $\frac{\omega v}{2m}$

(iii) $\frac{\omega}{2mv}$

(iv) $2m(\omega \times v)$

2. (a) Give the physical significance of moment of inertia. 2

(b) A body of mass 0·2 kg is revolving along a circular path of radius 1 m with a frequency 4 Hz. Determine the magnitude of orbital angular momentum. 2

(c) Find the theoretical limit of Poisson's ratio. 2

(d) Show that under central force the motion takes place in a plane. 2

(e) Show that in SHM the acceleration is directly proportional to its displacement. 2

3. Write down Galilean transformation equations and establish that velocity is variant but acceleration is invariant under Galilean transformation. 1+2+2=5

4. *(a)* Establish that a conservative force is a negative gradient of potential energy function *U*. 3

   (b) Find an expression for moment of inertia of a rectangular lamina about an axis perpendicular to its plane and passing through the centre of mass. 5

   Or

   Find an expression for moment of inertia of a solid cylinder about an axis passing through the centre of mass and perpendicular to the axis of symmetry.

5. *(a)* A particle of mass m_2 is initially at rest. Another particle of mass m_1 is moving with a velocity u strikes the particle at rest. If the collision is 1-D elastic collision, find the expression for gain of KE of the particle of mass m_2. 3

   (b) Show that $x^2 + y^2 + z^2 - c^2t$ is invariant under Lorentz transformation. 3

   (c) Derive an expression for the gravitational potential due to spherical shell at a point outside the shell. 5

(Continued)

6. Derive the formula of variation of mass of a particle with its relativistic velocity. 5

7. *(a)* What are different equilibriums? Explain with the help of *U-x* graph. 3

   (b) Define coefficient of viscosity. Write its dimensional formula. 1½+½=2

8. What are forced and damped oscillations? Write their differential equation and show them graphically. 2+2=4

   Or

   State and prove the theorem of perpendicular axes of moment of inertia. 1+3=4

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