TDC (CBCS) Odd Semester Exam., 2024

PHYSICS

(1st Semester)

Course No. : PHSHCC–102T

(Mechanics)

Full Marks : 50
Pass Marks : 20

Time : 3 hours

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

UNIT—I

1. Answer any *two* of the following questions :

    2×2=4

    (a) Define elastic and inelastic collisions.

    (b) Define work and energy. Write down the statement of work-energy theorem.

    (c) Write down two differences between conservative and non-conservative forces.

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2. Answer any *one* of the following questions :   6

(a) Derive the expressions of final velocities after collision for an elastic collision. A 10 kg mass travelling 2 m/s meets and collides elastically with a 2 kg mass travelling 4 m/s in the opposite direction. Find the final velocities of both objects.   3+3=6

(b) (i) Show that the motion of two particles of masses m_1 and m_2 can be reduced to single particle.   3

     (ii) Derive the expression of acceleration of centre of mass for an isolated system.   3

UNIT—II

3. Answer any *two* of the following questions :   2×2=4

(a) Define torque and angular momentum of a particle.

(b) Define elasticity. Write down the statement of Hooke's law.

(c) State the principle of conservation of angular momentum.

4. Answer any *one* of the following questions :   6

(a) (i) Derive the relation, $Y = 2\eta(1+\sigma)$, where, $Y =$ Young's modulus, $\eta =$ rigidity modulus and $\sigma =$ Poisson's ratio.   3

     (ii) Explain Young's modulus and rigidity modulus.   3

(b) (i) Define moment of inertia and radius of gyration.   2

     (ii) Obtain the expression of moment of inertia for a cylindrical body about an axis along its length and passing through its centre.   4

UNIT—III

5. Answer any *two* of the following questions :   2×2=4

(a) Explain global positioning system (GPS).

(b) State the law of gravitation.

(c) State the Kepler's laws.

6. Answer any *one* of the following questions :   6

(a) Explain gravitational potential. Derive the expression of gravitational potential at the centre of a solid sphere.   2+4=6

(b) (i) Explain geosynchronous orbits and weightlessness. 3

(ii) Obtain Kepler's third law of planetary motion from law of gravitation. 3

UNIT—IV

7. Answer any *two* of the following questions : 2×2=4

(a) Define simple harmonic oscillation. Write down the differential form of simple harmonic oscillation.

(b) What do you mean by Coriolis force and centrifugal force?

(c) Explain inertial and non-inertial frames.

8. Answer any *one* of the following questions : 6

(a) Obtain the differential equation of damped oscillation and find its solution if damping factor (b) is equal to natural frequency (ω).

(b) Explain power dissipation and quality factor.

UNIT—V

9. Answer any *two* of the following questions : 2×2=4

(a) State the postulates of special theory of relativity.

(b) Explain Lorentz contraction.

(c) Explain mass-energy equivalence.

10. Answer any *one* of the following questions : 6

(a) (i) Write down the Lorentz transformation. 2

(ii) Derive Einstein mass-energy relation. 4

(b) Explain relativistic addition of velocities. Hence show that no particle can travel faster than velocity of light. 4+2=6

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