



2022/TDC/ODD/SEM/PHSHCC-102T/148

TDC (CBCS) Odd Semester Exam., 2022

PHYSICS

(Honours)

(1st Semester)

Course No. : PSHCC-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 from the following questions : 2×2=4

(a) Write the expression for momentum and force for a variable mass system.

(b) For a projectile, fired at certain angle in uniform gravitational field, show that there are two angles of projection possible for the same horizontal range.



(2)

(c) State the law of conservation of energy. Explain with an example.

2. (a) Explain what are meant by conservative and non-conservative forces. Show that the force can be expressed as the gradient of potential in case of conservative forces. 6

Or

(b) Distinguish between elastic and inelastic collision. Find a relation connecting angle of scattering in laboratory and centre of mass frames. 2+4=6

UNIT—II

3. Answer any two from the following questions : 2+2=4

(a) Define torque and angular momentum. How are they related?

(b) Using the relations among the elastic coefficients, find the limiting values of Poisson's ratio.

(3)

(c) A force $\vec{F} = 2\hat{i} + 2\hat{j} + \hat{k}$ N acts on a particle having position vector

$$\vec{r} = \hat{i} + 2\hat{j} + \hat{k} \text{ (in meter)}$$

w.r.t. an arbitrary origin. Find the work done.

4. (a) (i) Obtain a relation connecting torque and angular momentum.

(ii) State and prove the law of conservation of angular momentum. Based on this, mention the consequences of melting of polar ice caps on the rotation of the earth. 3+2+1=6

Or

(b) Define the three elastic coefficients, Young's modulus (Y), rigidity modulus (η) and bulk modulus (K). Obtain a relation connecting Y , η and K . 6

UNIT—III

5. Answer any two from the following questions : 2+2=4

(a) Explain the equivalence of gravitational and inertial mass.



(4)

- (b) Give a brief description of the global positioning system (GPS).
- (c) What is meant by weightlessness?
6. (a) State Newton's law of gravitation. Define gravitational potential. Find the gravitational potential inside and outside of a spherical shell. $1+1+4=6$
- Or
- (b) State Kepler's laws of planetary motion. Derive Kepler's law of areal velocity. $3+3=6$

UNIT—IV

7. Answer any two from the following questions : $2 \times 2 = 4$
- (a) What is centrifugal force? Explain with example.
- (b) Explain with an example, what is meant by resonance.
- (c) Show that for a body, executing simple harmonic motion, the total mechanical energy is always conserved.

J23/81

(Continued)

(5)

8. (a) A frame of reference rotates with a uniform angular velocity. Find the expressions for position, velocity and acceleration when observations made from it. Show that such a frame is non-inertial. $4+2=6$
- Or
- (b) Explain free, damped and forced oscillations. Obtain the differential equation in case of damped oscillation. Discuss the case of heavy damping. $2+4=6$

UNIT—V

9. Answer any two from the following questions : $2 \times 2 = 4$
- (a) Show that, in case of Galilean transformation, acceleration is invariant but velocity is non-invariant.
- (b) Write a short note on mass-energy equivalence.
- (c) Explain how mass varies with velocity.

J23/81

(Turn Over)



10. (a) State the postulates of special theory of relativity. Explain (i) simultaneity and (ii) length contraction in case of relativistic motion. 2+2+2=6

Or

(b) Obtain Lorentz transformation equation in case of relativistic speed. 6
