



**2021/TDC/CBCS/ODD/  
PHSHCC-102T/148**

**TDC (CBCS) Odd Semester Exam., 2021  
held in March, 2022**

**PHYSICS**

**( 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*

**SECTION—A**

Answer any *ten* of the following questions :

$2 \times 10 = 20$

1. Define stable and unstable equilibrium.
2. What are conservative and non-conservative forces?
3. Write two differences between elastic and in-elastic collision.



( 2 )

4. Define angular momentum. How is it related with torque?
5. State and prove the law of conservation of angular momentum.
6. Explain why hollow shafts are preferred over solid ones for transmitting large torques in a rotating machinery.
7. Differentiate between inertial mass and gravitational mass.
8. Calculate gravitational potential on the surface of a spherical shell.
9. Assuming the earth to be a sphere of radius  $R$ , show that gravitational field intensity and potential at any point on the earth's surface can be expressed as  $g$  and  $gR$  respectively, where  $g$  is the acceleration due to gravity.
10. If the displacement of a moving point at any instant of time  $t$  is given by

$$x = a \cos \omega t + b \sin \omega t$$

where  $a$  and  $b$  are constants and  $\omega$  = angular frequency. Show that the motion is simple harmonic.

22J/573

( Continued )

( 3 )

11. What is meant by simple harmonic motion? Mention some of its properties.
12. What is Coriolis force? Mention its one application.
13. Show that the length is invariant under Galilean transformation.
14. State the postulates of special theory of relativity.
15. Write a short note on relativistic time dilation.

SECTION—B

Answer any *five* of the following questions :  $6 \times 5 = 30$

16. Show that the trajectory of a projectile fired at an angle with the horizontal direction is parabolic in nature. Find an expression for the horizontal range.
17. (a) State and prove work-energy theorem. 4  
(b) Show that force can be expressed as the negative gradient of the potential. 2

22J/573

( Turn Over )



( 4 )

18. Define moment of inertia and radius of gyration. Find the moment of inertia of a solid cylinder about an axis passing perpendicularly through the middle of its length. 2+4=6
19. Define Young's modulus, rigidity modulus and Poisson's ratio. Obtain the relation  $Y = 2\eta(1 + \sigma)$ , where  $Y$  = Young's modulus,  $\eta$  = rigidity modulus and  $\sigma$  = Poisson's ratio. 2+4=6
20. Define gravitational potential. Show that the gravitational at the centre of a solid sphere is  $\frac{3}{2}$  times that on the surface. 2+4=6
21. (a) Give a brief description of GPS. 2  
(b) Obtain Kepler's 3rd law from Newton's law of gravitation. 4
22. (a) Obtain the differential equation of SHM and solve it. 4  
(b) Show that total energy is conserved during simple harmonic motion. 2

( 5 )

23. Obtain the transformation equation for potential velocity for a uniformly rotating frame of reference. Show that such a frame is non-inertial in nature.
24. What is the meaning of mass-energy equivalence? Obtain Einstein's mass-energy relation. Show that 1 a.m.u. = 931 MeV. 2+3+1=6
25. Describe the Michelson-Morley experiment and explain the physical significance of the negative result.

\*\*\*