K24U 4028

Reg. No. : ....

Name : ....

**First Semester B.Sc. Degree (C.B.C.S.S. – OBE-Supplementary/
Improvement) Examination, November 2024
(2019 to 2023 Admission)
CORE COURSE IN PHYSICS
1B01PHY : Mechanics – I**

Time : 3 Hours   Max. Marks : 40

PART – A

All questions are compulsory. **Each** question carries **1** mark.

1. State the Newton's law of gravitation. Express it in vector form.

2. Name two contact forces and two non-contact forces.

3. State work-energy theorem.

4. What do you mean by a central force ?

5. How is torque related to angular momentum ?

6. Explain parallel axis theorem using a diagram.   (6×1=6)
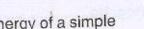
PART – B

Answer **any 6**. **Each** question carries **2** marks.

7. What are the conditions to apply exerted force F = ma ?

8. How does the acceleration due to gravity vary with altitudes ? Obtain an expression for the fractional change in g with distance from the centre of earth.

9. How does tensional force develop in a stretched string ? Give atleast 2 properties of tensional force.

10. Write the expressions of velocity and acceleration in plane polar co-ordinates.

P.T.O.

K24U 4028   -2-

11. Draw the plots of total energy, kinetic energy and potential energy of a simple harmonic oscillator.

12. Consider a conical pendulum and assume that the pendulum is in steady circular motion with constant angular velocity ω. Find angular momentum about origin which is fixed at pivot of the conical pendulum.

13. Planetary motion is confined to a single plane. Comment on the statement considering that gravitational force is a central force.

14. Obtain expression for time period of oscillation for a simple pendulum using small angle approximation.   (6×2=12)

PART – C

Answer **any 4**. **Each** question carries **3** marks.

15. Assume two astronauts A and B, initially at rest, in free space plays a tug of war by pulling on either end of a rope. Astronaut A is stronger than astronaut B. Let the maximum force with which A can pull, F_A, Is larger than the maximum force with which B can pull, F_B. Their masses are M_A and M_B. Find the acceleration of each astronaut ? Who will be winning the game ?

16. The potential energy function of an interaction is given as $U = x^3 - 3x^2$. Find the points of equilibria. Find the point of stable equilibrium.

17. Find amount of work done by a force $F = 2x\hat{i} + 2y\hat{j} + 3\hat{k}$ while moving a particle from point (1,1,1) to (1, 2, 1).

18. A particle of mass 3 kg is moving with velocity 4i along the line y = 3 in the x-y plane.
    a) What is its angular momentum about the origin ?
    b) What is its angular momentum about (0, 3, 0) ?

19. Find the torque on a body of mass M about an arbitrary point A due to the gravitational field g.

20. Derive the general expression for the law conservation of mechanical energy if a nonconservative force is also present.   (4×3=12)

-3-   **K24U 4028**

PART – D

Answer **any 2**. **Each** question carries **5** marks.

21. a) State the law of conservation of linear momentum.

    b) The piston of a spring gun has mass m and is attached to one end of a spring with spring constant k. The projectile is a marble of mass M. The piston and the marble are pulled back a distance L from the equilibrium position and suddenly released. Derive the expression for the speed of the marble as it losses contact with the piston.

22. A drum major's baton consists of two masses m_1 and m_2 separated by a thin rod of length l. Analyze the movement of baton when thrown in to air. Show that motion of centre of mass of the baton can be compared to motion of a single object of mass $m_1 + m_2$ under the influence of gravity.

23. Consider the following 2 cases in which the same object is being shot to outer space from Earth's surface. Find expression for escape velocity in each case and compare the result.
    a) Object is shot vertically upward from the surface of earth.
    b) Object is being shot by making an angle α with the radial vector from the centre of the earth.

24. Derive the expressions for the moment of inertia of the following objects
    a) A uniform thin ring of mass M and radius R, about an axis through one edge and perpendicular to the plane of the ring.
    b) A uniform disc of mass M and radius R, about an axis through one edge and perpendicular to the plane of the loop.   (2×5=10)

———————