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D1BPH2201 (S2) **Reg. No.....**

Name: .....

FIRST SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2024
(Improvement/Supplementary)
PHYSICS
GPHY1B01T: MECHANICS - I

Time: 2 Hours **Maximum Marks: 60**

SECTION A: Answer the following questions. Each carries *two* marks.
(Ceiling 20 marks)

1. State and provide a proof for the parallel axis theorem.
2. Calculate the torque and angular momentum of a particle moving within a central force field.
3. Find the MI of a thin uniform stick of mass 'M' and length 'L' about an axis passing through the midpoint and perpendicular to the length.
4. Analyze the tug-of-war scenario among astronauts in space, employing a force diagram for explanation.
5. Determine the force acting on a pulley when it redirects a tensioned rope.
6. Explain the operational principle of a Bola weapon.
7. Define central force and demonstrate that the work done by a central force is path-independent.
8. What is a fictitious force? How is it related to the apparent force on a system?
9. Write any two limitations of Newton's laws.
10. Illustrate that force can be expressed as the negative potential gradient.
11. Derive the expression for the vibrational frequency of a diatomic molecule.
12. Check the force $\vec{F} = (y^2 - x^2)\hat{\imath} + 2xy\,\hat{\jmath}$ is conservative or not?

SECTION B: Answer the following questions. Each carries *five* marks.
(Ceiling 30 marks)

13. Explain the principle of the Atwood machine and obtain the expression for the acceleration.
14. A uniform drum of radius b and mass M rolls without slipping down a plane inclined at an angle θ . The moment of inertia of the drum around its axis is $I_0 = Mb^2/2$. Find the drum's acceleration along the plane.
15. What are the steps in applying Newton's laws?

(PTO)

16. On a horizontal table without friction, there is a small hole in the center. Block B, with a mass of m_B, is positioned on the table and is connected via a massless string that passes through the hole to block A, which has a mass of m_A and is hanging beneath the table. Draw the force diagram for this system and provide the equation of motion.
17. A uniform rope of mass *m* and length *L* is attached to a block of mass M. The rope is pulled with force F. Find the tension at a distance *x* from the end of the rope. Neglect gravity.
18. Show that under the action of viscous force, velocity decreases exponentially with time.
19. What is the final velocity of the loaded spring gun, which has a mass of M and is initially at rest on a horizontal frictionless surface, after it fires a marble of mass m at an angle of elevation θ with an initial velocity of v_i?

SECTION C: Answer any *one* question. The question carries *ten* marks.

20. Examine the behaviour of objects in a gravitational field that follows an inverse square law. Derive an equation for the escape velocity of Earth by applying the work-energy theorem. Determine the escape velocity for both Earth and the Moon and provide their respective values.
21. Describe the concept of the conservation of angular momentum and elucidate its underlying principle. Demonstrate that for central force motion, angular momentum is preserved, resulting in a constant areal velocity.

(1 × 10 = 10 Marks)