D 12652 **(Pages : 3)** **Name.....**

Reg. No.....

FIRST SEMESTER (CBCSS—UG) DEGREE EXAMINATION
NOVEMBER 2021

Physics/Applied Physics

PHY 1B 01/APH 1B 01—MECHANICS—I

(2021 Admissions)

Time : Two Hours Maximum : 60 Marks

The symbols used in the question paper have their usual meanings.

Section A (Short Answer Type)

Answer at least **eight** *questions.*
Each question carries 3 *marks.*
All questions can be attended.
Overall Ceiling 24.

1. State Newton's third law of motion and give various examples to illustrate it.
2. What are the fundamental forces in nature ? Compare their strengths.
3. State work-energy theorem for a conservative system. How does dissipative force modify the description ?
4. Explain central force. Show that the work done by a central force is path independent.
5. Obtain the expression for change in acceleration due to gravity with height.
6. Define moment of inertia. How is it related to angular momentum ?
7. What are conservative forces ? Give examples.
8. Show that angular momentum is conserved for a particle in central force motion.
9. Define centre of mass of a system of particles. Obtain an expression for it.
10. Define power of a mechanical system. Calculate the expression for power of an object falling from a height, assuming acceleration due to gravity is a constant.
11. State the law of conservation of linear momentum with one example.
12. State and explain parallel axis theorem.

(8 × 3 = 24 marks)

Turn over

Section B (Paragraph / Problem Type)

Answer at least **five** *questions.*
Each question carries 5 *marks.*
All questions can be attended.
Overall Ceiling 25.

13. A 5 kg mass moves under the influence of a force $F = \left(4t^2 \hat{i} - 3t \hat{j}\right)$ N, where t is the time in seconds, (1N = 1 Newton). It starts at rest from the origin at $t = 0$. Find :

    (a) Its velocity ;

    (b) Its position ; and

    (c) $r \times v$, for any later time.

14. State and prove parallel axis theorem. Apply it to obtain the moment of inertia of a thin stick about its end.

15. 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 distance x from the end of the rope. Neglect gravity.

16. Analyze the molecular vibration of a diatomic molecule and calculate the fundamental frequency. Draw the Potential Energy curve.

17. Show that :

    (a) If the total linear momentum of a system of particles is zero, the angular momentum of the system is the same around all origins.

    (b) Show that if the total force on a system of particles is zero, the torque on the system is the same around all origins.

18. A loaded spring gun, initially at rest on a horizontal frictionless surface, fires a marble at angle of elevation θ .The mass of the gun is M, the mass of the marble is m, and the muzzle velocity of the marble (the speed with which the marble is ejected, relative to the muzzle) is v_0. What is the final motion of the gun ?

19. Three freight cars each of mass M are pulled with force F by a locomotive. Friction is negligible. Find the force on each car ?

(5 × 5 = 25 marks)

Section C (Essay Type)

Answer any **one** *question.*
The question carries 11 *marks.*

20. Derive general statement of work-energy theorem for translational motion. Apply this to obtain the escape velocity of a mass projected from earth's surface.

21. Define potential energy :

    (a) Obtain Potential energies of a uniform force field ;

    (b) Obtain Potential energy of a central force ; and

    (c) Obtain the Potential energy of the Three-dimensional Spring Force.

(1 × 11 = 11 marks)