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ST. THOMAS COLLEGE LIBRARY THIRUVANANTHAPURAM

Reg. No. : .....

Name : .....

First Semester B.Sc. Degree Examination, March 2023

First Degree Programme under CBCSS

Physics

Core Course – I

PY 1141 – BASIC MECHANICS AND PROPERTIES OF MATTER

(2018 Admission Onwards)

Time : 3 Hours Max. Marks : 80

SECTION – A

Answer ALL questions in **1** or **2** sentences; each question carries **1** mark.

1. State the condition for translational equilibrium of a body.
2. How is angular momentum related to linear momentum?
3. State perpendicular axis theorem.
4. What is meant by simple harmonic motion?
5. What is energy density of a wave?
6. What is a compound pendulum?
7. What do you mean by Poisson's ratio?
8. What is the difference between streamline and turbulent flows?
9. What is bending moment of beam?
10. Define coefficient of viscosity.

(10 × 1 = 10 Marks)

P.T.O.

SECTION – B

Answer **any eight** questions, not exceeding a paragraph; each question carries **2** marks.

11. Derive an expression for the moment of inertia of a solid sphere.
12. Calculate the moment of inertia of a circular cylinder of radius R and length h about a line at right angles to its axis and passing through the middle point.
13. Obtain an expression for moment inertia of a uniform bar of rectangular cross section.
14. State and explain work energy theorem.
15. How do you find the acceleration due to gravity using bar pendulum?
16. Explain the difference between progressive wave and stationary wave.
17. Obtain an expression for equation of motion of a torsional pendulum.
18. State and explain Bernoulli's theorem.
19. What is cantilever? Write an expressions for depression of cantilever when the load is fixed at the centre.
20. Obtain an expression for twisting couple per unit twist of a wire.
21. Derive the relation connecting between three elastic constants.
22. Explain why small drops of mercury are spherical while large ones are flat?

(8 × 2 = 16 Marks)

SECTION – C

Answer **any six**, each question carries **4** marks.

23. A solid cylinder of mass 20kg rotates about its axis with angular speed 100 rad/sec. The radius of the cylinder is 0.25m. What is the kinetic energy associated with the rotation of the cylinder? What is the magnitude of angular momentum of the cylinder about its axis?

24. A flywheel in the form of a solid circular disc of mass 5000kg and radius 1 meter is rotating making 120 revolutions per minute. Compute the kinetic energy.

25. A solid sphere of mass 100gm and radius 2.5cm rolls without sliding with a uniform velocity of 10 cm per second along a straight line on a smooth horizontal table. Calculate its total energy?

26. A particle moves along half the circumference of a circle of 1 meter radius. Calculate the work done if the force at any point is inclined at 60° to the tangent at the point and has 5 newtons magnitude.

27. The total energy of a particle executing a simple harmonic motion of period 2π second is 10.24×10^{-4} joule. The displacement of the particle at $\pi/4$ second is $8\sqrt{2}$ cm. Calculate the amplitude of the motion?

28. If in air a plane wave of frequency 256 Hz and amplitude 1/1000 mm is produced. Calculate the radiated energy per unit volume and the energy current. Given velocity of sound = 332m/sec and density of air = 1.29kg/m^3.

29. A light metal rod of length 60cm and of radius 1 cm is clamped at one end loaded at the free end, with 5.5 kg. Calculate the depression of the free end, assuming $Y = 9 \times 10^{11}$ dynes/sq.cm and g = 980 cm/sec^2.

30. What would be the pressure inside a small air bubble of 0.1 mm radius, situated just below the surface of water? Surface tension of water = 0.072 n/m and atmospheric pressure $=1.013 \times 10^5$ n/m^2.

31. A spherical ball of radius 1×10^{-3}m and density 10^4kg/m^3 falls freely under gravity through a distance *h* before entering a tank of water. If after entering the water, the velocity of the ball does not change. Find *h*. The coefficient of viscosity of water is 9.8×10^{-4} n.s/m^2.

(6 × 4 = 24 Marks)

SECTION – D

Answer **any two** questions; each question carries **15** marks.

32. Derive an expression for the moment of inertia of a solid cylinder about an axis through its centre of mass and perpendicular to its own axis.

33. Derive an expression of moment of inertia of a flywheel.

34. Derive an expression for the energy density of the plane progressive waves.

35. Derive Stokes's formula for the velocity of small sphere falling through a viscous fluid.

(2 × 15 = 30 Marks)