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S – 2679

Reg. No. :

Name :



First Semester B.Sc. Degree Examination, January 2024

First Degree Programme under CBCSS

Physics

Complementary Course for Mathematics

PY 1131.1 : MECHANICS AND PROPERTIES OF MATTER

(2023 Admission)

Time : 3 Hours

Max. Marks : 80

SECTION – A

Answer **all** questions. Each question carries **1** mark.

1. State the theorem of perpendicular axes
2. Write the expression for the moment of inertia of a uniform bar of rectangular cross section about an axis perpendicular to the length of the bar and passing through the centre of mass.
3. Define simple harmonic motion(SHM).
4. Define energy current and give the expression.
5. Define Poisson's ratio.
6. What is meant by flexural rigidity of a wire?
7. Small drops of liquid assume spherical shape. Why?

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8. What is the excess pressure inside a soap bubble of radius 'R'?
9. What is the effect of temperature on the viscosity of fluids?
10. Define coefficient of viscosity.

(10 × 1 = 10 Marks)

SECTION – B

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

11. Calculate the moment of inertia of a solid sphere about a diameter.
12. Derive the expression for the kinetic energy of a rotating body.
13. Give the expression for the energy density and energy current for a plane progressive wave.
14. Write down the differential equation for the oscillation of a torsion pendulum and hence give the expression for its period.
15. Explain angle of twist and angle of shear.
16. Steel girders are generally made I shaped. Why?
17. From the differential equation of a two body harmonic oscillator, give the expression for its period
18. Represent graphically the variation of kinetic energy and potential energy of a particle executing SHM.
19. What is a Neumann's triangle? Explain its significance.
20. Explain variation of surface tension with temperature.
21. If the length of the capillary tube in Poiseuille's experiment is doubled and radius is halved, how will it affect the rate of flow of liquid.
22. How do you determine the moment of inertia of a flywheel.

(8 × 2 = 16 Marks)

SECTION – C

Answer any six, Each question carries 4 marks.

23. Assuming the earth to be spherical, calculate the angular momentum about its own axis. Mass of the earth = 6×10^{24} Kg, Radius of the earth = 6400 Km.
24. A wheel of mass 5 Kg and radius of gyration 40/cm is rotating at 500 rpm. Find the moment of inertia and kinetic energy of the wheel.
25. The equation for the displacement of a particle executing SHM is $x(t) = 0.6 \sin(2\pi t + \pi/3)$ m. Calculate
 - (a) Maximum speed of the particle.
 - (b) The speed when $t = 0$
 - (c) The period and
 - (d) Frequency
26. Two masses 10g and 90g are connected by a spring of length 10cm and force constant 10^3Nm^{-1} . Calculate the frequency of oscillation
27. Check whether $y = x^2 + v^2 t^2$ is a solution to the one dimensional wave equation.
28. Show that a hollow shaft of the same length mass and material is comparatively stronger than a solid shaft.
29. A wire of length l m and diameter 10^{-3} m fixed at one end is twisted through 70° by a force of 5×10^{-3} Kg wt applied to each end of 0.2m length rod soldered at its middle point to the other end of the wire. Calculate the rigidity modulus of the wire.
30. Two plane glass plates have water drop pressed between them spreading as a circle of diameter 10cm. The plates are 0.005mm apart. What force perpendicular to the plates will be required to separate them? Surface tension of water = $72 \times 10^{-3} \text{Nm}^{-1}$.
31. Find the volume of water that will flow per minute through a pipe of diameter 4cm and length 200m when a pressure of 5 Pa is applied assuming that the flow is streamline. Viscosity of water = 0.001 SI units.

(6 × 4 = 24 Marks)

SECTION – D

Answer any **two**, **Each** question carries **15** marks.

32. State parallel axes theorem. Derive an expression for the moment of inertia of a uniform bar of rectangular cross section about an axis passing through its corner and perpendicular to its length.
33. Derive an expression for bending moment. Describe in detail an experiment to determine Young's modulus of the material of the rod using cantilever.
34. Derive an expression for the rate of flow of a liquid through a capillary tube. Explain the corrections
35. Show that the pressure variations in a medium due to a sound wave is given by $P = -E dy/dx$ and hence derive an expression for the velocity of longitudinal waves in a solid rod.

(2 × 15 = 30 Marks)