

**E 6545**



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Reg. No.....

Name.....

**B.Sc. DEGREE (C.B.C.S.S.) EXAMINATION, SEPTEMBER 2024**

**First Semester**

Complementary Course—Physics

PROPERTIES OF MATTER, MECHANICS AND FOURIER ANALYSIS

(For the subject Mathematics Model I and Statistics)

[2013—2016 Admissions]

Time : Three Hours

Maximum Marks : 60

**Part A**

*Answer **all** questions.*

*Each question carries 1 mark.*

1. Define stress.
2. Define Young's modulus.
3. What is a cantilever.
4. What do you mean by moment of inertia.
5. A symmetric body is rotating about  $x$ -axis what will be the direction of angular momentum vector.
6. Write the unit of torque.
7. Write the differential equation of SHM.
8. What is the fundamental period of  $\cos 2x$ .

(8 × 1 = 8)

**Part B**

*Answer any **six** questions.*

*Each question carries 2 marks.*

9. Why is a cantilever of uniform cross section more likely to break near its fixed end ?
10. Draw load-extension graph of an elastic material and verify Hookes law.

**Turn over**





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11. A steel wire of radius is 1 mm. is bent in the form of a circular arc of radius 50 cm. Calculate the bending moment. Given  $Y = 2 \times 10^{11}$  dynes/cm<sup>2</sup>.
12. State perpendicular axis theorem.
13. What is a symmetric top ? Is it always cylindrical ?
14. Define angular velocity. Obtain an expression for it.
15. Give the significance of Quality factor.
16. Define simple harmonic motion. Give an example.
17. Define modulus of decay for a damped oscillating system.
18. Write a Euler co-efficients for a periodic function of period  $2L$ .

(6 × 2 = 12)

### Part C

Answer any **four** questions.

Each question carries 4 marks.

19. (i) What is a rigid body ?  
(ii) Obtain the expression for rotational kinetic energy of a body.
20. Define Poisson's ratio. Calculate poisson's ratio for silver. Given Young's modulus for silver is  $7.25 \times 10^{10}$  Nm<sup>-2</sup> and Bulk modulus is  $11 \times 10^{10}$  Nm<sup>-2</sup>.
21. A wire of 2 mm. diameter and length 2 m. is twisted through 90°. Calculate the angle of shear at the surface and at the axis of wire. If the modulus of rigidity is  $5 \times 10^{11}$  dynes cm<sup>-2</sup>, what is the torsional couple.
22. Derive an expression for rise of temperature of earth, it if suddenly stops rotating.
23. State and prove conservation of angular momentum.
24. Find the Fourier series for the function :

$$f(x) = \begin{cases} 0 & \text{if } -2 < x < -1 \\ k & \text{if } -1 < x < 1. \\ 0 & \text{if } 1 < x < 2 \end{cases}$$

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(4 × 4 = 16)





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**Part D**

*Answer any **two** questions.*

*Each question carries 12 marks.*

25. Show that a shearing stress is equivalent to an equal linear tensile stress and an equal compression stress at right angles to each other.
26. A cube of mass  $M$  and each side ' $a$ ' is rotating with angular velocity  $\omega$  around one of its edges called  $x$ -axis, find expressions for its angular momentum and kinetic energy.
27. Show that oscillations of a compound pendulum is simple harmonic and derive its period.
28. Find the Fourier cosine series which represents  $f(x) = \pi - x$  where  $0 < x < \pi$  assuming the convergence of the series at  $x = 0$ , deduce  $\frac{\pi^2}{8} = 1 + \frac{1}{3^2} + \frac{1}{5^2} + \frac{1}{7^2} + \dots$

(2 × 12 = 24)

