PDPM-Indian Institute of Information Technology, Design & Manufacturing Jabalpur

NS-1002 (Quiz-2)

Engineering Mechanics

Instructions:

- All questions are mandatory.
- Marks are given on the R.H.S. of each question.
- Make the clear diagram wherever required.

Max. Marks: 10
Time: 45 min.
Date: Nov. 28, 2023

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1. Calculate the angular momentum of a body whose rotational kinetic energy is 10 Joules. The angular momentum vector coincides with the axis of rotation and the moment of inertia about this axis is 8 gm-cm^2. [2]

2. Prove that in the absence of external torque, the angular momentum is conserved. [3]

3. Find the moment of inertia of uniform half elliptical disc about its major axis. Write all the steps in detail. [5]

Best Wishes

$\frac{1}{2} I\omega^2 = 10J$

$\omega^2 = \frac{20}{8/4} \times 10^3 \times 10^4$

$\omega = \frac{\sqrt{10}}{2} \times 10^3$

$= \frac{10^4}{2} = 5000 rad/s$

$L = I\omega$

$= 8 \times 5000 rad$

$10^3 \times 10^4$

$=$

8

$L = r \times p$

$= m \times m/s$

$= m^2/s$

$L = m(r \times v)$

$= Kg\, m^2/s$

$L = m(r \times v)$

$= mrv$

$= mr^2 \times \frac{v}{r}$

$= I\omega$

m

$\sin\theta = 1 \quad \theta = \pi/2$

$\sin\theta = -1 \quad \theta = 3\pi/2$

PDPM Indian Institute of Information Technology, Design & Manufacturing Jabalpur

NS-1002 (Mid-Sem. Exam)

Engineering Mechanics

Instructions:

- All questions are mandatory.
- Make clear diagram wherever required.
- Write all the answers in a clear hand writing.

Max. Marks: 20
Time: 02 Hrs.
Date: Oct. 11, 2023

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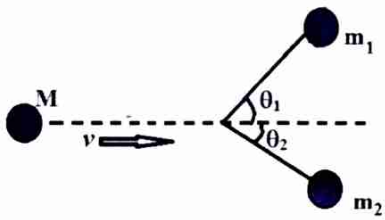
1. Using vector properties, prove that the three perpendiculars of a triangle are coincidental. [3]

2. Convert the following equations of cylindrical coordinates into equations of Cartesian coordinates: **(i)** $zr = 2 - r^2$ **(ii)** $4\sin\theta - 2\cos\theta = r/z$ [3]

3. A body of mass 3 kg collides elastically with another body at rest and then continues to move in the original direction with half of its initial speed. Find the mass of the second body. [3]

4. A mass M moves with speed v in the x-direction. It explodes into two pieces that go off at angles θ_1 and θ_2 as shown in the figure: Find the momenta of these pieces. [3]



5. Explain the physical significance of grad and find the expression of ∇ in the spherical coordinates. [4]

6. A body of mass M is suspended from a fixed point O by an inextensible uniform rope of mass m and length b. Find the tension in the rope at a distance z below O. The point of support now begins to rise with acceleration 2g. Now what would be the tension in the rope? [4]

Best Wishes

PDPM Indian Institute of Information Technology, Design & Manufacturing Jabalpur

NS-1002 (End-Sem. Exam)

Engineering Mechanics

Instructions:

- Do not exchange calculators.
- Make clear diagram wherever required.
- Write all the steps in a clear hand writing.

Max. Marks: 40
Time: 03 Hrs.
Date: Dec. 14, 2023

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1. Explain the principle of gyroscope and show that its velocity of precession is independent of the angle. [4]

2. A ball starts rolling down the plane inclined at an angle of 30°. If the ball starts from rest, how much time it will take to roll a distance of 7 meters. [5]

3. The angular velocity of a wheel increases from 1200 rpm to 4500 rpm in 10 sec. Find its angular acceleration and number of revolutions in this period. [5]

4. An electrical table is rotating table is rotating with 78 rpm. When power is turned off, it is stopped in 30 sec. Find angular acceleration and number of revolutions made after switching off. [5]

5. Find the moment of inertia of a lemniscates $r^2 = a^2 \sin 2\theta$ (Fig. 1) about an axis ON which is perpendicular to its plane. [5]

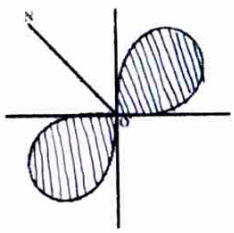


Fig. 1

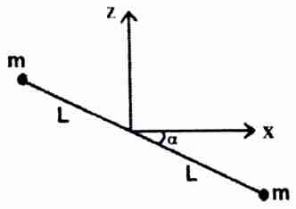
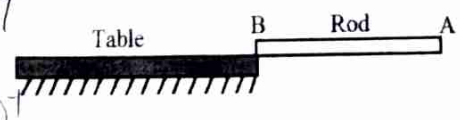


Fig. 2

6. Determine the torque (using two different methods) for a system of two identical masses separated by a mass-less rod of length 2L [Fig. 2]. The rod is skewed at an angle α and rotates around z axis with angular velocity ω. [5]

7. Find the moment of inertia tensor of a uniform cone spinning about its vertex. [5]

8. A uniform rod of mass m and length l is suspended at the edge of a table. Find: (i) angular acceleration about B (ii) vertical acceleration of centre of mass (iii) vertical force at B. [6]



Best Wishes