B.E. MECHANICAL ENGINEERING SECOND YEAR SECOND SEMESTER EXAM 2024

SUBJECT: ADVANCED ENGINEERING MECHANICS

Time : Three hours **FULL MARKS 100**

ANSWER ANY FIVE QUESTIONS. ALL QUESTIONS CARRY EQUAL MARKS

Assume appropriate value for any missing data

Q1. A motor as shown in Figure Q1 reaches a speed of 3000 rev/min in 2 seconds from rest with **constant** acceleration, determine the total angular acceleration of the rotor and the disc 1/3 second after it is turned on if the turntable is rotating at a constant rate N=30 rev/min. The angle $\gamma = 30^0$ is constant.

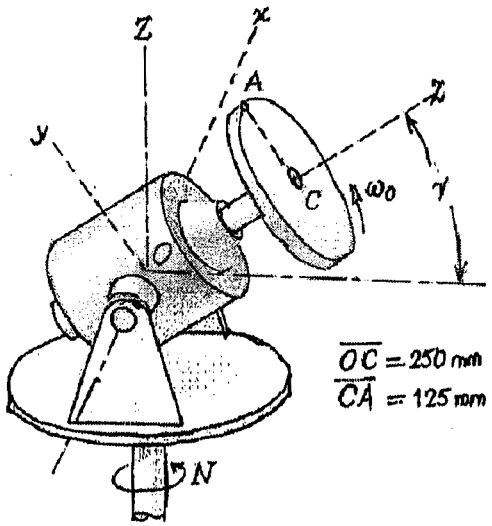

Figure Q1

Q2. For the instant represented collar B (Figure Q2) is moving along the fixed shaft in X direction with a constant .velocity $v_B = 4m/s$. Also at this instant X=0.3m and Y=0.2m. Calculate the velocity of collar A, which moves along the fixed shaft parallel to the Y axis.

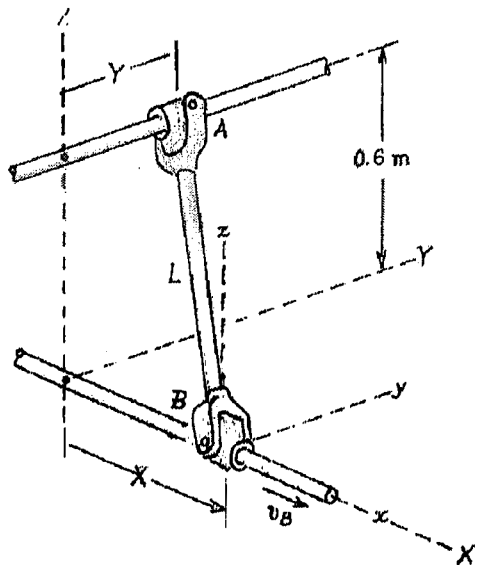

Figure Q2

Q3. The 100 mm-radius wheel has a mass of 3kg and turns about the y'axis with an angular velocity $p = 40\pi\ rad/s$ in the direction shown. Simultaneously the fork rotates about its x axis shaft with an angular velocity $\omega = 10\pi\ rad/s$ as indicated in Figure Q3. Calculate the angular momentum of the wheel about O' and O. Also, find out the kinetic energy of the wheel.

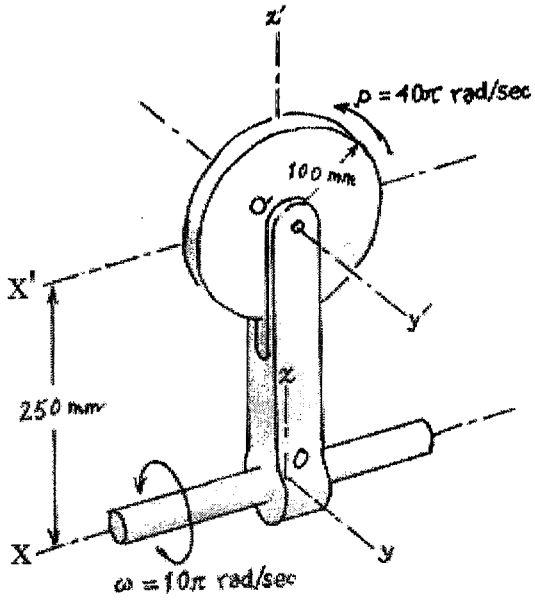

Figure Q3

Q4. Starting from moment and angular momentum relation derive Euler's equation

What is steady precession?

Draw a diagram of an axisymmetric body in steady precession with 90^onutation angle. Show spin and precession speeds. Assume precession speed is small. Show angular momentum vector and its change. From figure show $\bar{M} = I\,\bar{\Omega}_p \times \bar{\omega}_s$

Q5. A continuous prismatic beam, as shown in Figure Q5a, having two equal spans $L/2$ carries a uniformly distributed load of intensity w over one span only. Find the reaction at the support at C and compute the bending moment there.

You may use the formula given in Figure Q5b.

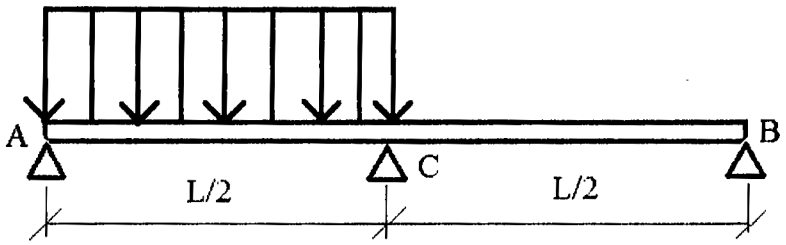

Figure Q5a

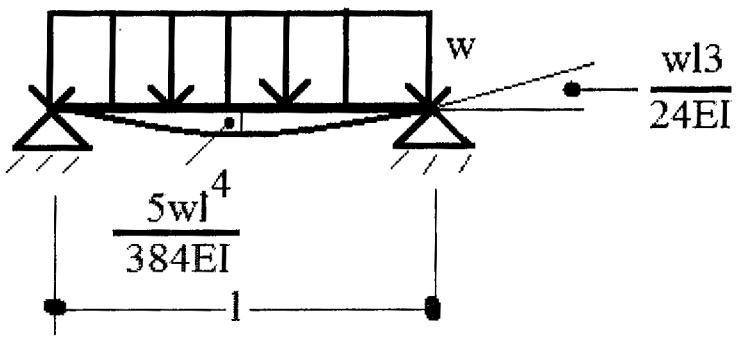

Figure Q5b

Q6. A simple truss ABC with pinned joints is loaded as shown in Figure Q6. Both bars are made of steel and have the same cross-sectional area A. Using Castigliano's theorem, find the horizontal displacement of the joint A.

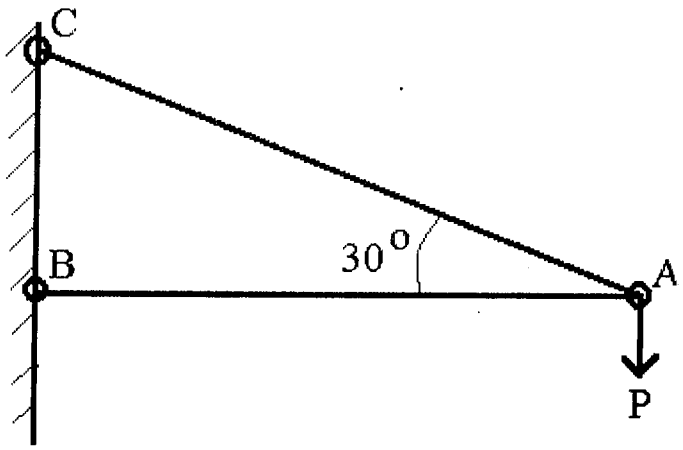

Figure Q6

Q7. Explain the working principle of a 45^o strain rosette.

Draw a Mohr's circle for the following state of stain:-

$$\epsilon_{xx} = -300\ \mu\varepsilon, \epsilon_{yy} = -100\ \mu\varepsilon\ and\ \gamma_{xy} = 100\ \mu\varepsilon$$

Show the principal strains and their locations in the diagram. Use graph paper.