

Quiz - II (15.05.2021)

Full Marks: 60

- (a)** Determine the reaction forces and reaction moment at the support O. **[2 marks]**
- (b)** Identify the two force members in the figure. **[1 mark]**
- (c)** Determine the magnitude and the nature of the force in the member AB. **[5 marks]**
- (d)** Determine the component of forces acting at the location C on the member BCD. **[1 mark]**
- (e)** Draw the shear force and bending moment diagram from the location O to C along the axis of the member OE? **[6 marks]**

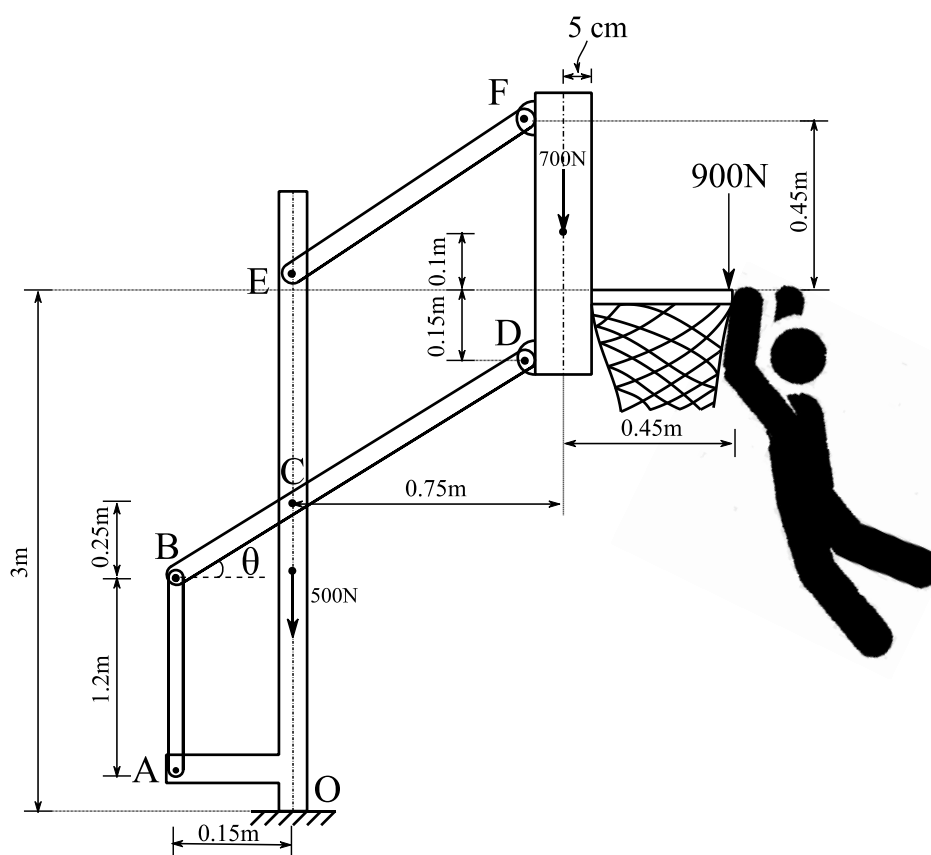


Figure 1

2. A brass cone having a base diameter of 40 cm and a height of 60 cm is placed on top of a vertical steel cylinder of the same diameter and a height of 40 cm. Determine the mass moment of inertia of the composite body about the vertical geometric axis. Take the density of brass as 8400 kg/m^3 and that of steel as 7850 kg/m^3 . **[10 Marks]**
3. Determine the magnitude and location of the resultant hydrostatic force acting on the inclined submerged rectangular plate as shown in **Figure 2**. Given data: $Z_1 = 2 \text{ m}$, $Z_2 = 5 \text{ m}$, $L = 4 \text{ m}$, $b = 2 \text{ m}$ and density of the liquid is $\rho = 1000 \text{ kg/m}^3$. Take $g = 9.81 \text{ m/s}^2$. **[2 + 3 = 5 marks]**

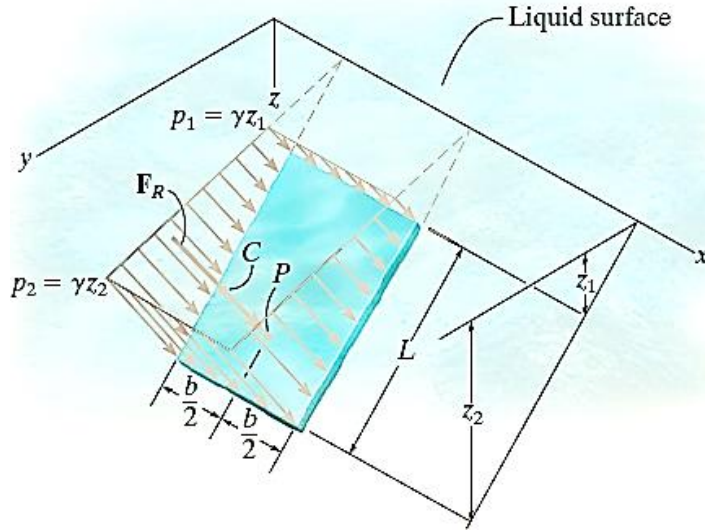


Figure 2

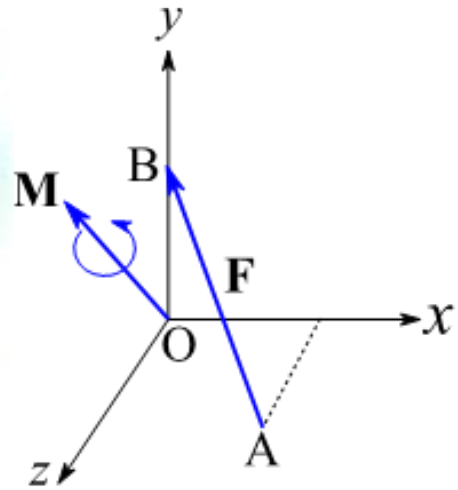


Figure 3

4. A system consists of a couple $\mathbf{M} = 72\hat{j} + 36\hat{k}$ (N-m) and a force $F = 30$ N as shown in **Figure 3**. Find the (x, y, z) coordinates in x - z plane at which the wrench is formed. The co-ordinates of A and B are A (4 m, 0, 2 m) and B (0, 4 m, 0) respectively. [4 + 6 = 10 marks]

5. (a) The variation of acceleration a of a particle with velocity V is given by $a = \frac{5}{V^2}$. Find the expression for velocity and displacement in terms of time assuming the body starts with initial velocity of 2 m/s and initial displacement of 3 m. Plot the variation of velocity with displacement and schematically show how you can determine acceleration graphically when time $t = 5$ sec. You may, use Matlab/any other tool for plotting purpose. [2+2+2+2 Marks]

- (b) The robotic device rotates about a fixed vertical axis while its arm extends and elevates as shown in **Figure 4**. At a given instant $\phi = 45^\circ, \dot{\phi} = 20$ deg/s = constant, $d = 0.5$ m, $\dot{d} = 0.2$ m/s, $\ddot{d} = -0.25$ m/s², $\Omega = 0$ deg/s = constant.

If the arm is in x - y plane, determine the magnitude of the velocity and acceleration of the gripper P . Also, write the velocity and acceleration using the Cartesian coordinate system x, y .

[7 marks]

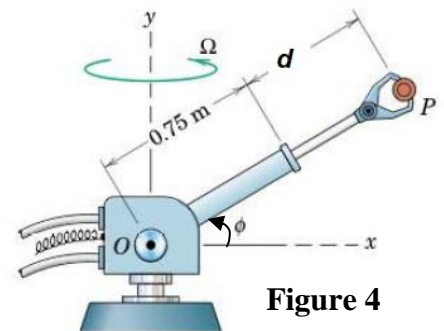


Figure 4

6. (a) Define virtual work principle. With the help of a schematic diagram, show stable, unstable and neutral equilibrium points and their relation with potential energy. [3 Marks]

- (b) Using virtual work principle, determine Weight W (**Figure 5**), if the effort $P = 250$ N is required to hold the weight W in equilibrium in a system of two frictionless pulleys of the same diameter. [2 Marks]

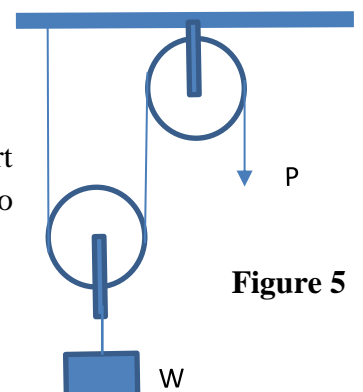


Figure 5