ME 203 - Quiz 2

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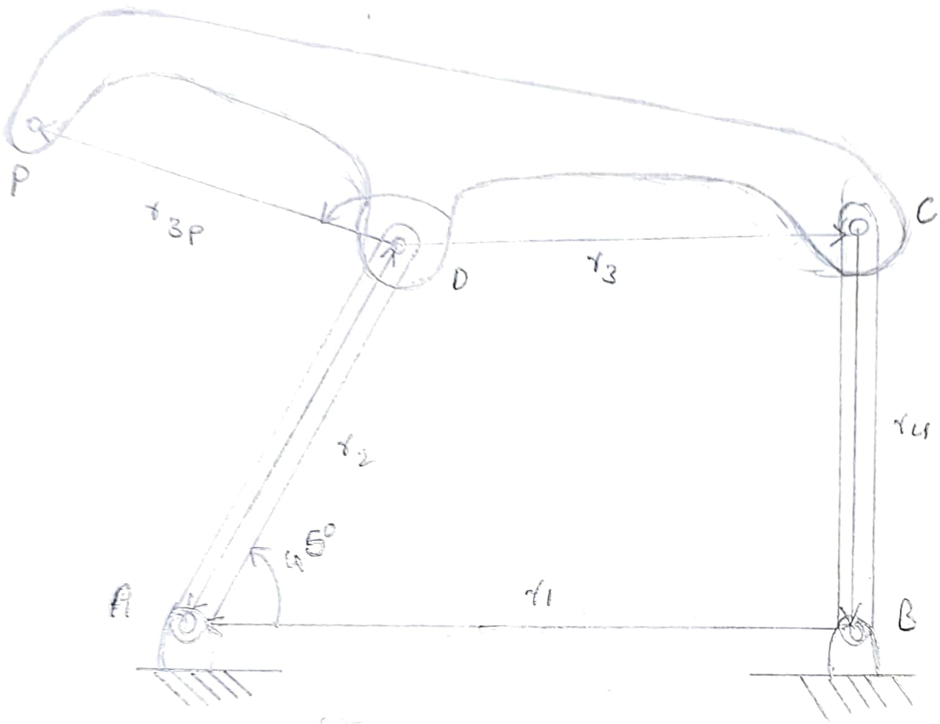
19ME133

Q1)



→ Given:-

$r_1 = 161$ cm $\qquad \theta_2 = 45^\circ$

$r_2 = 141$ cm $\qquad \omega_2 = 0.5$ rad/s

$r_3 = 120$ cm $\qquad r_{3P} = 200$ cm

$r_4 = 100$ cm $\qquad \alpha_{3P} = 135^\circ$

→ To find : V_P

→ We know that

$$\vec{r}_1 + \vec{r}_2 + \vec{r}_3 + \vec{r}_4 = 0 \qquad \text{— (i)}$$

where $\vec{r}_1 = r_1 e^{i\theta_1}$

$$\theta_{3p} = \theta_3 + \alpha_{3p} \quad \text{— (ii)}$$

differentiating (i) and (ii) with time $\Rightarrow t$

$$r_2 \omega_2 i e^{i\theta_2} + r_3 \omega_3 i e^{i\theta_3} + r_4 \omega_4 i e^{i\theta_4} = 0$$

— (iii)

$$\omega_{3p} = \omega_3 \quad \text{— (iv)}$$

$\Rightarrow$ $\vec{AP} = \vec{r_2} + \vec{r_{3p}}$

$$V_p = \frac{d(\vec{AP})}{dt} = \frac{d(\vec{r_2} + \vec{r_{3p}})}{dt}$$

$$= r_2 \omega_2 i e^{i\theta_2} + r_{3p} \omega_{3p} i e^{i\theta_{3p}}$$

— (v)

$\rightarrow$ Using equation (iii) for x axis — (vi)

$$+r_2 \omega_2 \sin\theta_2 + r_3 \omega_3 \sin\theta_3 + r_4 \omega_4 \sin\theta_4 = 0$$

$\Rightarrow$ Using equation (iii) for y axis — (vii)

$$r_2 \omega_2 \cos\theta_2 + r_3 \omega_3 \cos\theta_3 + r_4 \omega_4 \cos\theta_4 = 0$$

$\rightarrow$ Using equation (v) for x axis

$$V_{px} = -r_2 \omega_2 \sin\theta_2 - r_{3p} \omega_{3p} \sin\theta_{3p} \quad \text{— (viii)}$$

$\rightarrow$ For y axis

$$V_{py} = r_2 \omega_2 \cos\theta_2 + r_{3p} \omega_{3p} \cos\theta_{3p} \quad \text{— (ix)}$$

solving equation (vi) and (vii)

(vi) $\rightarrow$ $+141 \times \frac{1}{2} \times \frac{1}{\sqrt{2}} + 120 \times \cancel{\omega_3} \times \overset{0}{0} + 100 \times \omega_4 \times \sin(-90) = 0$

(vii) $\rightarrow$ $141 \times \frac{1}{2} \times \frac{1}{\sqrt{2}} + 120 \times \omega_3 \times 1 + 100 \times \cancel{\omega_4} \times \overset{0}{0} = 0$

Thus we have :-

$\omega_4 = 0.4985$

$\omega_3 = -0.4154$

From equation (iv)

$\omega_{3P} = \omega_3 = -0.4154$

Thus

$V_{px} = -141 \times 0.5 \times \sin 45 - 200 \times (-0.4154) \times \sin 135.$

$= 8.896$

$V_{py} = 141 \times 0.5 \times \cos 45 + 200 \times (-0.4154) \times \cos 135$

$= 108.6$

$V_p = \sqrt{V_{px}^2 + V_{py}^2}$

$= \sqrt{8.896^2 + 108.6^2}$

$= 108.96$ cm/s