AKADEMIA EDUKACYJNO - INŻYNIERSKA

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MATURA STUDIA PRAKTYKA STAŻ PRACA BIZNES PRZEMYSŁ STEAM

KOMPLEKSOWE WSPARCIE EDUKACYJNE **ON – LINE** NA KAŻDYM ETAPIE KSZTAŁCENIA INŻYNIERSKIEGO

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MECHANIKA II

"DYNAMIKA - UKŁAD BRYŁ SZTYWNYCH"

PROJEKT

Oblicz:

- przemieszczenie
- prędkość
- przyspieszenie

liniowe i kątowe dla układu brył sztywnych.

DANE:

s_{IN}, $F_{IN} = OK$

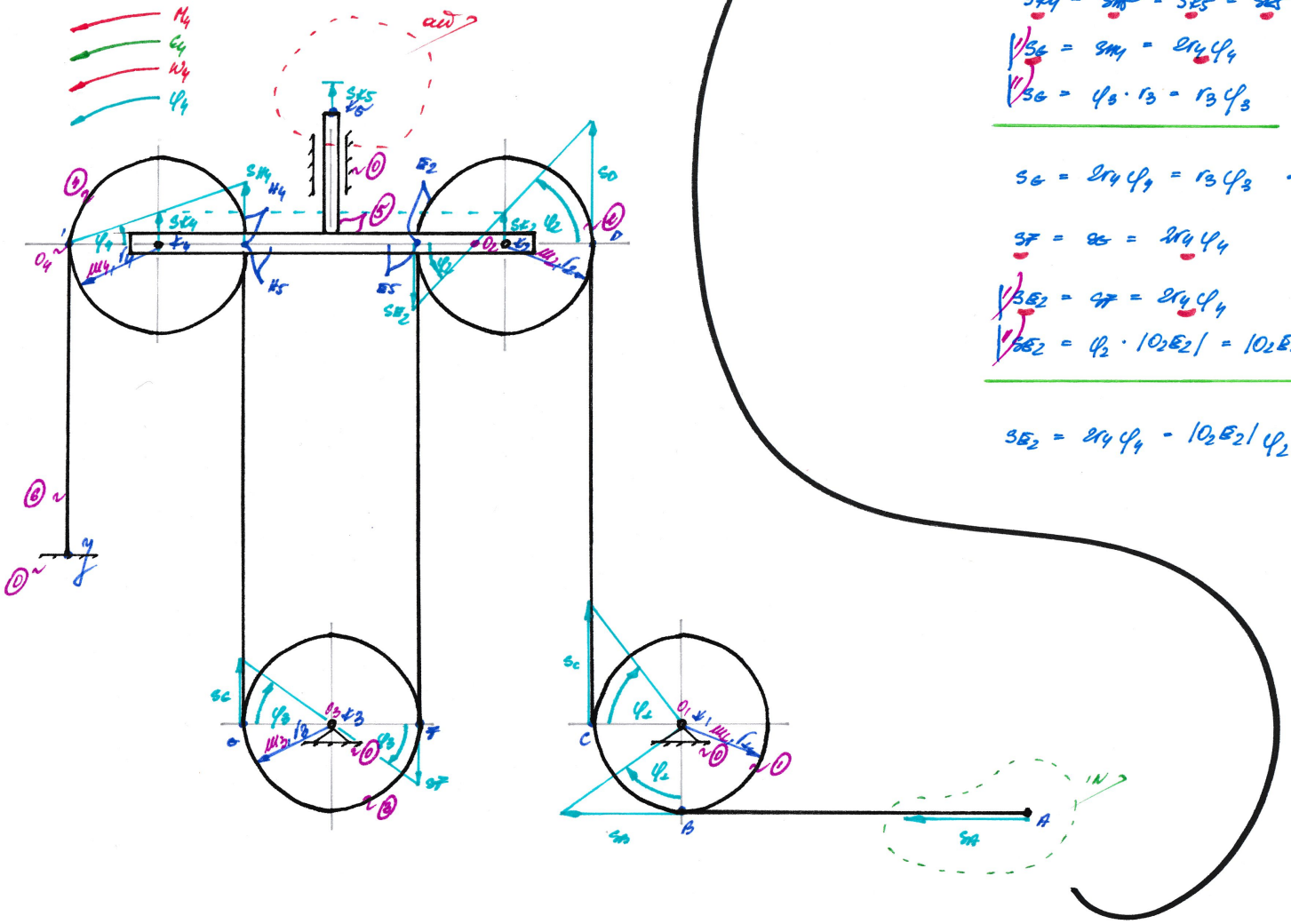
SZUKAM:

$s_{OUT}(s_{IN}) = ?$
$F_{OUT}(F_{IN}) = ?$

D : IN

SE : OUT

1) STUDIO STRUTTURALE CINEMATICO.



2) CINEMATICA.

$q = \varphi_4$

$s_{t4} = \varphi_4 \cdot r_4 = r_4 \varphi_4$

$s_{n4} = \varphi_4 \cdot 2r_4 = 2r_4 \varphi_4$

$s_{t4} = s_{n5} = s_{t5} = s_{t2} = r_4 \varphi_4$

I) $s_G = s_{n4} = 2r_4 \varphi_4$

II) $s_G = \varphi_3 \cdot r_3 = r_3 \varphi_3$

(+)

$s_G = 2r_4 \varphi_4 = r_3 \varphi_3 \Rightarrow \varphi_3 = \frac{2r_4}{r_3} \varphi_4$

$s_F = s_G = 2r_4 \varphi_4$

I) $s_{E2} = s_F = 2r_4 \varphi_4$

II) $s_{E2} = \varphi_2 \cdot |O_2 E_2| = |O_2 E_2| \varphi_2$

(+)

$s_{E2} = 2r_4 \varphi_4 = |O_2 E_2| \varphi_2 \Rightarrow \varphi_2 = \frac{2r_4}{|O_2 E_2|} \varphi_4$

$$\text{I)}\ \frac{SE_2}{|O_2E_2|} = \text{II)}\ \frac{SK_2}{|O_2K_2|} = \text{III)}\ \frac{SE_2 + SK_2}{|O_2E_2| + |O_2K_2|}$$

$$\text{I)}\ \frac{2r_4\varphi_4}{|O_2E_2|} = \text{II)}\ \frac{r_4\varphi_4}{|O_2K_2|} = \text{III)}\ \frac{2r_4\varphi_4 + r_4\varphi_4}{r_2}$$

$$\text{II, III)}\quad |O_2K_2| = \frac{r_4\varphi_4 \cdot r_2}{3r_4\varphi_4} = \frac{1}{3}r_2$$

$$|O_2E_2| + |O_2K_2| = r_2$$

$$|O_2E_2| = r_2 - |O_2K_2|$$

$$|O_2E_2| = r_2 - \frac{1}{3}r_2 = \frac{2}{3}r_2$$

$$\Rightarrow \quad \varphi_2 = \frac{2r_4}{|O_2E_2|}\varphi_4$$

$$\Rightarrow \quad \varphi_2 = \frac{2r_4}{\frac{2}{3}r_2}\varphi_4 = \frac{2r_4}{1}\cdot\frac{3}{2r_2}\varphi_4 = \frac{3r_4}{r_2}\varphi_4$$

$$S_D = \varphi_2 \cdot |O_2D| = (r_2 + |O_2K_2|)\varphi_2 =$$

$$= (r_2 + \frac{1}{3}r_2)\cdot\frac{3r_4}{r_2}\varphi_4 = \frac{4r_2}{3}\cdot\frac{3r_4}{r_2}\varphi_4 =$$

$$= 4r_4\varphi_4$$

$$\text{I)}\ S_C = S_D = 4r_4\varphi_4$$

$$\text{II)}\ S_C = \varphi_1 \cdot r_1 = r_1\varphi_1$$

$$\oplus$$

$$S_C = 4r_4\varphi_4 = r_1\varphi_1 \quad \Rightarrow \quad \varphi_1 = \frac{4r_4}{r_1}\varphi_4$$

$$S_{AB} = \varphi_1 \cdot r_1 = r_1\varphi_1 = r_1 \cdot \frac{4r_4}{r_1}\varphi_4 = 4r_4\varphi_4$$

$$S_{AA} = S_{AB} = 4r_4\varphi_4$$

$$S_{ACD}(\varphi_{AN}) = S_{AB}(m_A)$$

$$\text{I)}\ S_{AB}(\varphi_4) = r_4\varphi_4$$

$$\text{II)}\ S_A(\varphi_4) = 4r_4\varphi_4$$

$$\text{II)}\quad S_{AA} = 4r_4\varphi_4 \quad /:4r_4$$

$$\Rightarrow \quad \varphi_4 = \frac{S_{AA}}{4r_4}$$

$$\text{I)}\quad S_{AB} = r_4\varphi_4 \quad \Rightarrow \quad S_{AB}(m_A) = r_4\cdot\frac{S_{AA}}{4r_4} = \frac{1}{4}S_{AA}$$

$s_{KS}(\alpha) = \frac{1}{4} s_A$

$q - \varphi$ ⟹ I) $\omega = \dot{\varphi}$, II) $\varepsilon = \ddot{\varphi}$

$q - s$ ⟹ I) $v = \dot{s}$, II) $a^{\tau} = \ddot{s}$

⟹ I) $s_{KS}(\alpha) = \frac{1}{4} s_A$ ●
II) $a_{KS}(\alpha) = \frac{1}{4} a_A$ ●
III) $a_{KS}^{\tau}(\alpha r^{\perp}) = \frac{1}{4} \alpha r^{\perp}$ ●

KINEMATIKA

I) $s = \varphi \cdot r$
II) $v = \omega \cdot r$
III) $a^{\tau} = \varepsilon \cdot r$

DYNAMIKA

IV) $M = \mathcal{F} \cdot r$

$q = M_4$

$M_4 = \mathcal{F}_{t4} \cdot r_4$ ⟹ $\mathcal{F}_{t4} = \frac{M_4}{r_4}$

$M_4 = \mathcal{F}_{14} \cdot 2r_4$ ⟹ $\mathcal{F}_{14} = \frac{M_4}{2r_4}$

$\mathcal{F}_{14} = \mathcal{F}_{15} = \mathcal{F}_{15'} = \mathcal{F}_{15''} = \mathcal{F}_{C2} = \frac{M_4}{r_4}$

I) $\mathcal{F}_G = \mathcal{F}_{14} = \frac{M_4}{2r_4}$
II) $\mathcal{F}_G = \frac{M_3}{r_3}$

⊕

$\mathcal{F}_G = \frac{M_4}{2r_4} = \frac{M_3}{r_3}$ ⟹ $M_3 = \frac{r_3}{2r_4} M_4$

$\mathcal{F}_F - \mathcal{F}_G = \frac{M_4}{2r_4}$

I) $\mathcal{F}_{E2} = \mathcal{F}_F = \frac{M_4}{2r_4}$
II) $\mathcal{F}_{E2} = \frac{M_2}{|O_2E_2|}$

⊕

$\mathcal{F}_{E2} = \frac{M_4}{2r_4} = \frac{M_2}{|O_2E_2|}$ ⟹ $M_2 = \frac{|O_2E_2|}{2r_4} M_4$

$|O_2E_2| = \frac{2}{3} r_2$

$|O_2K_2| = \frac{1}{3} r_2$

⟹ $M_2 = \frac{|O_2E_2|}{2r_4} M_4 = \frac{\frac{2}{3} r_2}{2r_4} M_4 = \frac{r_2}{3r_4} M_4$

$\mathcal{F}_D = \frac{M_2}{|O_2D|} = \frac{M_2}{|r_2 + O_2K_2|} = \frac{\frac{r_2}{3r_4} M_4}{r_2 + \frac{1}{3} r_2} =$

$= \frac{\frac{2}{3r_4}}{\frac{4r_2}{3}} M_4 = \frac{M_4}{4r_4}$

I) $\mathcal{F}_C = \mathcal{F}_D = \frac{M_4}{4r_4}$
II) $\mathcal{F}_C = \frac{M_L}{r_L}$

⊕

$\mathcal{F}_C = \frac{M_4}{4r_4} = \frac{M_L}{r_L}$ ⟹ $M_L = \frac{r_L}{4r_4} M_4$

$\mathcal{F}_B = \frac{M_L}{r_L} = \frac{r_L}{4r_4} \frac{M_4}{r_L} = \frac{M_4}{4r_4}$

$\mathcal{F}_A = \mathcal{F}_B = \frac{M_4}{4r_4}$

$$T_{out}(T_{in}) = T_{KS}(T_A)$$

I) $T_{KS}(M_4) = \frac{M_4}{r_4}$

II) $T_A(M_4) = \frac{M_4}{4r_4}$ ⊕

II) $T_A = \frac{M_4}{4r_4} \quad | \cdot 4r_4$

$\Rightarrow M_4 = 4r_4 T_A$

I) $T_{KS} = \frac{M_4}{r_4}$

$\Rightarrow T_{KS}(T_A) = \frac{4r_4}{r_4} T_A = 4T_A$

$$i_{OUT/IN} = \frac{s_{OUT}}{s_{IN}} = \frac{T_{IN}}{T_{out}}$$

I) $i_{OII} = \frac{s_{KS}}{s_A} = \frac{\frac{1}{4} s_A}{s_A} = \frac{1}{4}$

II) $i_{OII} = \frac{T_A}{T_{KS}} = \frac{T_A}{4T_A} = \frac{1}{4}$

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