MECG – 1051: MECÁNICA DE MAQUINARIA

EXAMEN PARCIAL – 2025 – 1T

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Matrícula: (Propuesta)

Tema 1 (30 puntos)

En el sistema mostrado en la figura, la velocidad angular del eje A es de 350 rad/min en la dirección mostrada, y la correspondiente al eje B es de 2000 rad/min. Determinar la velocidad angular del eje C.

Datos

$\omega_A = 350 \frac{rad}{min}$ (⟸)

$\omega_B = 2000 \frac{rad}{min}$ (⟹)

$\omega_C = ??$

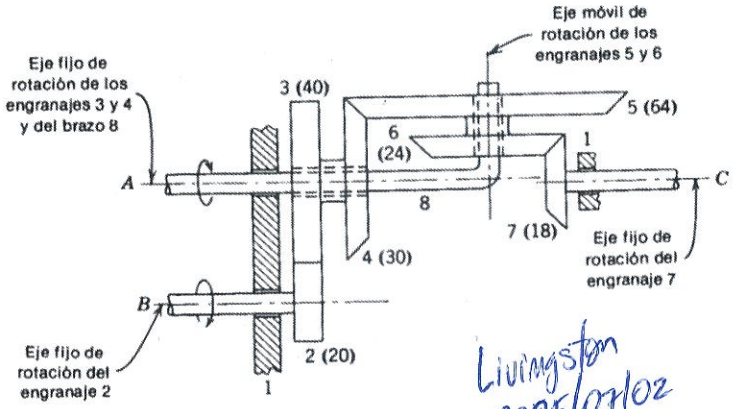

Figura 1. Sistema de transmisión de engranes planetarios.

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I.) ⟹ (+)

II.) $\frac{\omega_3}{\omega_2} = -\frac{N_2}{N_3} \rightarrow \omega_3 = -\left(\frac{N_2}{N_3}\right)\omega_2^{\omega_B} = -\left(\frac{20}{40}\right)\left(2000 \frac{rad}{min}\right) \rightarrow \omega_3 = -1000 \frac{rad}{min}$

$\omega_3 = \omega_4$

$\frac{\omega_{7B}}{\omega_{4B}} = \frac{\omega_7 - \omega_B}{\omega_4 - \omega_B}$; $\frac{\omega_{7B}}{\omega_{4B}} = (-)\left(-\frac{N_4}{N_5}\right)\left(-\frac{N_6}{N_7}\right)$ → cambio de sistema → $\vec{i} \rightarrow \vec{j}$

$\frac{\omega_{7B}}{\omega_{4B}} = -\left(-\frac{30}{64}\right)\left(-\frac{24}{18}\right) = -0.625$

$\frac{\omega_7 - \omega_B}{\omega_4 - \omega_B} = \frac{\omega_{7B}}{\omega_{4B}} \Rightarrow \omega_7 - \omega_B = \left(\frac{\omega_{7B}}{\omega_{4B}}\right)(\omega_4 - \omega_B) \rightarrow \omega_7 = \left(\frac{\omega_{7B}}{\omega_{4B}}\right)(\omega_4 - \omega_B) + \omega_B$

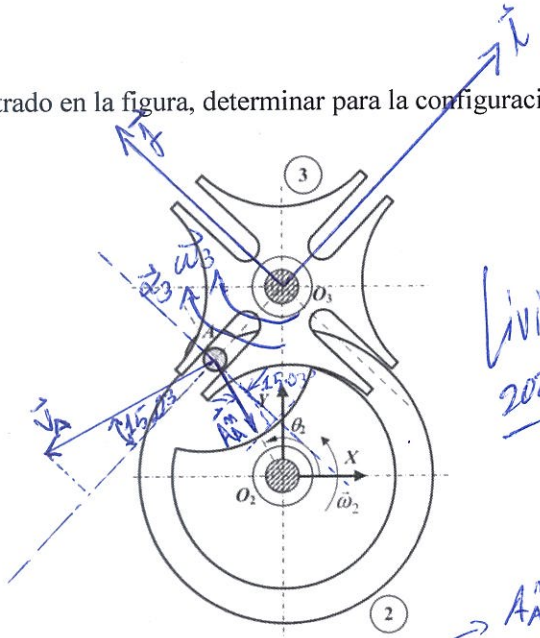
$\rightarrow \omega_7 = \left[(-0.625)(-1000 - (-350))\right] + (-350) \Rightarrow \omega_7 = +56.25 \frac{rad}{min}$ (⟲)

Tema 2 (70 puntos)

Dado el mecanismo de Cruz de Malta mostrado en la figura, determinar para la configuración del mecanismo indicada:

a) La velocidad angular del eslabón 3.
b) La aceleración angular del eslabón 3.

Datos geométricos del mecanismo:
O2O3= 82 mm, 02A=60 mm.
Datos cinemáticos del mecanismo:
θ2= 120°, ω2= 10 (k) rad/s, constante.



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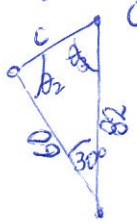
I.) Sistemas de referencia

II.) geometría



$C^2 = 60^2 + 82^2 - 2(60)(82)\cos(30°)$

$C = 42.415\ mm$

$\theta_3 = \sin^{-1}\left[\frac{60\sin 30°}{42.45}\right]$

$\rightarrow \theta_3 = 44.47°$

$\theta_2 = 180° - 44.47$

$\Rightarrow \theta_2 = 105.03°$

III.) $\vec{V}_A = \vec{V}^{\vec{0}}_{O_3} + \vec{V} + (\vec{\omega}_3 \times \vec{r}_{A/O_3})$

$\vec{V}_A = |\vec{V}_A|[-\cos(15.03)(\vec{i}) + \sin(15.03)(\vec{j})]$

$\vec{V} = V(-\vec{i})$

$\vec{\omega}_3 \times \vec{r}_{A/O_3} = \omega_3(-\vec{k}) \times r_{A/O_3}(-\vec{i}) = \omega_3 r_{A/O_3}(\vec{j})$

$\Rightarrow (\vec{i}): -V_A \cos 15.03 = -V$

$(\vec{j}): +V_A \sin 15.03 = \omega_3 r_{A/O_3}$

$\Rightarrow |\vec{V}_A| = \omega_2 r_{A/O_3} = (10)(60) = 600\ \frac{mm}{s}$

$\rightarrow V = 579.474\ (mm/s)$

$\rightarrow \omega_3 = \frac{(V_A)(\sin 15.03)}{r_{A/O_3}} = \frac{(600)(\sin 15.03)}{42.45\ mm}$

$\Rightarrow \omega_3 = 3.665\ rad/s$

$\rightarrow A^n_A = (10)^2(60) = 6000\ \frac{mm}{s^2}$

$\vec{A}_A = \vec{A}^{\vec{n}}_A + \vec{A}^{\vec{t}}_A = |\vec{A}^n_A|[-\sin 15.03(\vec{i}) - \cos 15.03(\vec{j})]$

$\vec{A}_A = \vec{A}^{\vec{0}}_{O_3} + \vec{A} + 2(\vec{\omega}_3 \times \vec{V}) + (\vec{\alpha}_3 \times \vec{r}_{A/O_3}) + (\vec{\omega}_3 \times (\vec{\omega}_3 \times \vec{r}_{A/O_3}))$

$\vec{A}_A = A(-\vec{i}) + 2(\omega_3(-\vec{k}) \times V(-\vec{i})) + (\alpha_3(-\vec{k}) \times r_{A/O_3}(-\vec{i})) + (\omega_3(-\vec{k}) \times [\omega_3(-\vec{k}) \times r_{A/O_3}(-\vec{i})])$

$|\vec{A}^n_A|[-\sin 15.03(\vec{i}) - \cos 15.03(\vec{j})] = -A(\vec{i}) + 2\omega_3 V(\vec{j}) + \alpha_3 r_{A/O_3}(\vec{j}) + (\omega_3)^2 r_{A/O_3}(\vec{i})$

$(\vec{i}): -A^n_A \sin 15.03 = -A + (\omega_3)^2 r_{A/O_3}$

$(\vec{j}): -A^n_A \cos 15.03 = +2\omega_3 V + \alpha_3 r_{A/O_3}$

$\rightarrow \alpha_3 = \frac{-|\vec{A}^n_A| \cos 15.03 - 2\omega_3 V}{r_{A/O_3}}$

$\Rightarrow \alpha_3 = \frac{-(6000)(\cos 15.03) - (2)(3.665)(579.474)}{(42.45\ mm)}$

$\rightarrow \alpha_3 = -236.567\ rad/s^2$