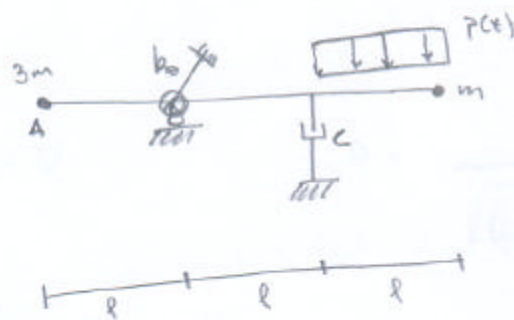


# Solución P1 E3 C1426



$$m = 40 \text{ kgf s}^2/\text{m}$$

$$f = 2 \text{ Hz}$$

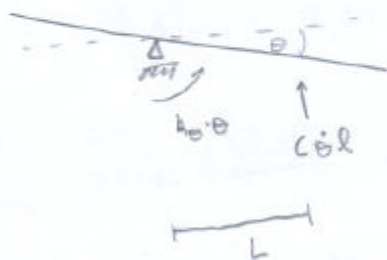
$$p(x) = 5 \sin(2\pi \cdot 0,5 \text{ Hz} \cdot x)$$

$$l = 1,5 \text{ m}$$

$$\beta = 3\%$$

a)  $k_0$ ? tal que  $f = 2 \text{ Hz}$

$$I_0 = 3m l^2 + m (2l)^2 = 4m l^2$$



Ec de Mov:

$$\underbrace{I_0}_{m^*} \ddot{\theta} + \underbrace{k_0}_{k^*} \theta + \underbrace{c l^2}_{c^*} \dot{\theta} = \underbrace{\frac{3l^2 \cdot 5}{2}}_{p_0^*} \sin(2\pi \cdot 0,5 \cdot t)$$

$$k^* = k_0 = \omega^2 m^* \Rightarrow k_0 = 4\pi^2 f^2 m l^2$$

$$= 4\pi^2 \cdot 2^2 \cdot 40 \cdot 1,5^2 \left[ \frac{1}{\cancel{\text{kgf}}} \cdot \frac{\text{kgf s}^2}{\text{m}} \cdot \text{m}^2 \right]$$

$$\Rightarrow \underline{k_0 = 99486 \text{ [kgf} \cdot \text{m]}}$$

b)  $c$ ? tal que  $\beta = 3\%$

$$c_c = 2m^* \omega \quad \beta = \frac{c^*}{c_c} \Rightarrow c = \frac{0,03 \cdot 2 \cdot 40 \cdot 1,5^2 \cdot 2\pi \cdot f}{\cancel{\text{kgf}}}$$

$$\Rightarrow c = 0,03 \cdot 2 \cdot 40 \cdot 2\pi \cdot 2 \left[ \frac{\text{kgf s}^2}{\text{m}} \cdot \frac{1}{\cancel{\text{s}}} \right]$$

$$\underline{c = 211,12 \frac{\text{kgf s}}{\text{m}}}$$

1 Amplitud máxima en régimen permanente considerando sólo la excitación sinusoidal

$$\theta_{max} = \theta_{est} \cdot D$$

$$D = \frac{1}{\sqrt{(1 - \beta^2)^2 + (2\beta\beta_1)^2}} \quad \text{con } \beta_1 = \frac{1}{2}$$

$$\bar{\omega} = 2\pi \cdot 0,5 = \pi \quad \text{rad/s}$$

$$\omega = 2\pi \cdot f = 4\pi \quad \text{rad/s}$$

$$\Rightarrow \beta = \frac{1}{3} = \frac{\pi}{4\pi} = 0,25$$

$$\beta = 0,03$$

$$\Rightarrow D = \frac{1}{\sqrt{(1 - 0,25^2)^2 + (2 \cdot 0,03 \cdot 0,25)^2}} \Rightarrow D = 1,067$$

$$P_0^* = M_{excitacion} = \frac{3}{2} l^2 \cdot S = 16,815 \quad \text{kgf} \cdot \text{m}$$

$$\theta_{est} = \frac{M_{est}}{k_\theta} = \frac{16,815}{99486} \left[ \frac{\text{kgf} \cdot \text{m}}{\text{kgf} \cdot \text{m}} \right] \Rightarrow \theta_{est} = 1,696 \cdot 10^{-4} \quad [\text{rad}]$$

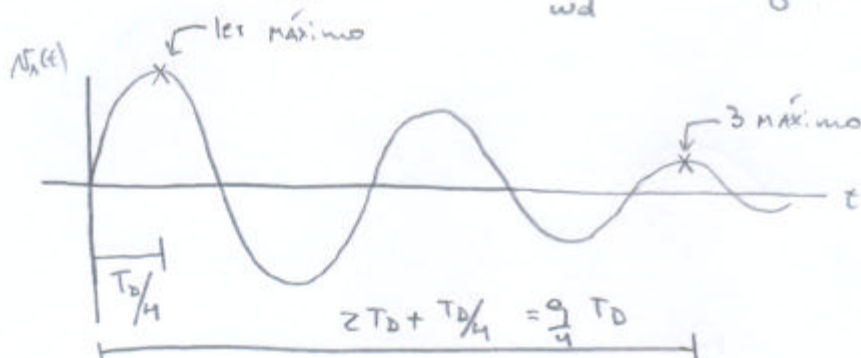
$$\Rightarrow \theta_{max} = 1,696 \cdot 10^{-4} \cdot 1,067 \Rightarrow \theta_{max} = 1,81 \cdot 10^{-4} \quad [\text{rad}] = 1,04 \cdot 10^{-2}^\circ$$

$$N_A(t) = e^{-\beta \omega t} \left[ \frac{\dot{N}_0 + N_0 \beta \omega}{\omega d} \sin(\omega d t) + N_0 \cos(\omega d t) \right]$$

↳ Solución de desplazamiento para el punto A

$$\Rightarrow N_A(t) = p e^{-\beta \omega t} \sin(\omega d t - \theta)$$

$$p = \sqrt{\left( \frac{\dot{N}_0}{\omega d} \right)^2 + 0} = \frac{\dot{N}_0}{\omega d} \quad \text{y } \theta = 0^\circ$$



$$|N_A(\frac{9}{4} T_D)| = \frac{\dot{N}_0}{\omega d} e^{-\beta \omega \frac{9 T_D}{4}}$$

Amplitud de desplazamiento en el pto A en el 3er ciclo

$$\omega_D = \omega \sqrt{1 - \beta^2} = 2\pi \cdot f \sqrt{1 - \beta^2} = 2\pi \cdot 2 \sqrt{1 - 0,03^2} \Rightarrow \omega_D = 12,561 \text{ rad/sec}$$

$$T_D = \frac{2\pi}{\omega_D} = 0,5002 \text{ sec}$$

$$|N_A(\gamma_A T_D)| = \frac{5}{12,56} \cdot e^{-0,03 \cdot 2\pi \cdot 2 \cdot \frac{9}{4} \cdot 0,5002} \Rightarrow \underline{\underline{|N_A(\gamma_A T_D)| = 0,260 \text{ m}}}$$