

$$W = 4 \text{ N}$$

$$m x''(t) + k x(t) = 0, \quad x(0) = 0,05 \text{ m}, \quad v_0 = x'(0) = -1$$

$$m = ? : W = m \cdot g \Rightarrow m = \frac{W}{g} = \frac{4 \frac{\text{kg} \cdot \text{m}}{\text{s}^2}}{9,81 \frac{\text{m}}{\text{s}^2}} = 0,41 \text{ kg}$$

$$k = ? : k x_0 = m \cdot g = W \Rightarrow k = \frac{W}{x_0} = \frac{4}{0,05} = 80 \frac{\text{N}}{\text{m}}$$

$$0,41 x''(t) + 80 x(t) = 0, \quad x(0) = 0,05, \quad x'(0) = -1$$

$$\rightarrow x(t) = C_1 \cos(\omega_0 t) + C_2 \sin(\omega_0 t) = C \cdot \cos(\omega_0 t - \gamma)$$

$$\omega_0 = \sqrt{k/m} = 13,97$$

$$x(0) = 0,05 = C_1 \cdot \cos 0 + C_2 \sin 0 = C_1$$

$$x'(t) = C_1 \cdot (-\sin(\omega_0 t)) \cdot \omega_0 + C_2 \cos(\omega_0 t) \cdot \omega_0$$

$$x'(0) = C_1 \cdot \sin 0 \dots + C_2 \cdot \cos 0 \cdot \omega_0 = -1$$

$$C_2 = -\frac{1}{\omega_0} = -0,0716$$

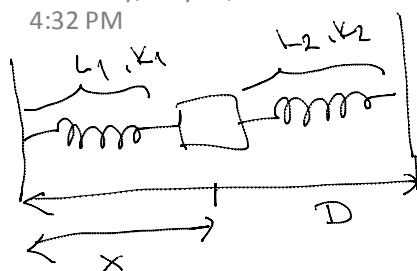
$$C = \sqrt{C_1^2 + C_2^2} = 0,0873$$

$$\gamma = \arctg \frac{C_2}{C_1} = -0,9612$$

$$x(t) = 0,0873 \cdot \cos(13,97t + 0,9612)$$

Thursday, May 20, 2021

4:32 PM



$$(x - L_1) \cdot k_1$$



$$(D - x - L_2) \cdot k_2$$

$$(x - L_1) \cdot k_1 = (D - x - L_2) \cdot k_2$$

$$x \cdot k_1 - L_1 k_1 = D k_2 - x \cdot k_2 - L_2 k_2$$

$$x(k_1 + k_2) = L_1 k_1 + D k_2 - L_2 k_2$$

$$x_R = \frac{L_1 k_1 + D k_2 - L_2 k_2}{k_1 + k_2} \quad \text{ravnotežna položaj}$$

$$F = -(x - L_1) \cdot k_1 + (D - x - L_2) \cdot k_2$$

$$m x'' = F$$

$$\left[\begin{aligned} m \cdot x'' + kx &= 0 \quad \leftarrow \\ (L_1 - x) \cdot k_1 + (D - x - L_2) \cdot k_2 + (k_1 + k_2)x &= 0 \end{aligned} \right.$$

$$m x'' = (L_1 - x) \cdot k_1 + (D - x - L_2) k_2$$

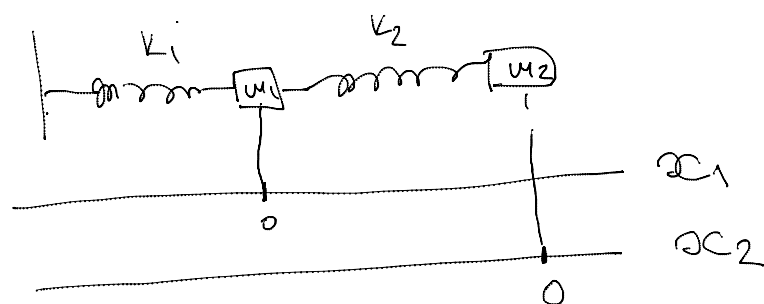
$$m x'' = L_1 k_1 - \underline{x k_1} + D k_2 - \underline{x k_2} - L_2 k_2$$

$$m x'' + (k_1 + k_2)x = \underbrace{L_1 k_1 + (D - L_2) k_2}_A$$

$$x_{02} = x_H + x_P$$

$$x(t) = \dots$$

$$x(0) = 0, \quad x'(0) = 0$$

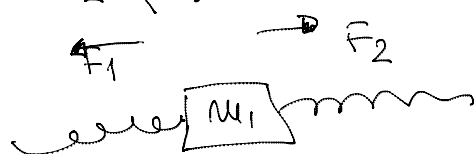


$$x_1(t) = ?$$

$$x_2(t) = ?$$

Telo 1: $-k_1 \cdot x_1(t) = F_1$ (I opruga)

$$k_2 \cdot (x_2(t) - x_1(t)) = F_2$$



$$m_1 \cdot x_1''(t) = -k_1 x_1(t) + k_2 (x_2(t) - x_1(t))$$

$$= -(k_1 + k_2) x_1(t) + k_2 x_2(t) \quad (*)$$

Telo 2: $\leftarrow F$

$$F = -k_2 (x_2(t) - x_1(t))$$

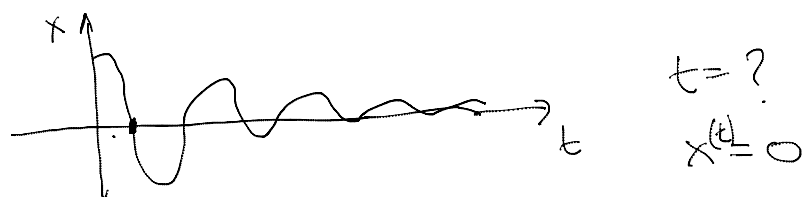
$$m_2 \cdot x_2''(t) = -k_2 (x_2(t) - x_1(t)) \quad (**)$$

(*) i (**) sistem D3 (2 me, 2 uop. x_1, x_2)

$$x_1(t) = \dots$$

$$x_2(t) = \dots$$

⑧ $m=1$, $c=0.125$, $k=1$, $x(0)=2$, $x'(0)=0$, $x(t)=0$



$$m x'' + c x' + k x = 0$$

$$x'' + 0.125 x' + x = 0$$

$$\lambda^2 + 0.125 \lambda + 1 = 0 \Rightarrow \lambda_{1,2} = -0.0625 \pm 0.998i$$

$$x(t) = e^{-pt} (c_1 \cos \omega_1 t + c_2 \sin \omega_1 t)$$

$$p = \frac{c}{2m}, \quad \omega_1 = \sqrt{\omega_0^2 - p^2}, \quad \omega_0 = \sqrt{\frac{k}{m}} = 1$$

$$\frac{1}{16}, \quad 0.998 = \frac{\sqrt{255}}{16}$$

$$x(t) = e^{-\frac{1}{16}t} \left(c_1 \cos \frac{\sqrt{255}}{16} t + c_2 \sin \frac{\sqrt{255}}{16} t \right)$$

$$= \underline{C} \cdot e^{-pt} \cos(\omega_1 t - \delta)$$

$$x(0) = e^0 (c_1 \cos 0 + c_2 \sin 0) \Rightarrow c_1 = 2$$

$$x'(t) = \dots$$

$$x'(0) = -\frac{1}{16} c_1 + c_2 \frac{\sqrt{255}}{16} = 0 \Rightarrow c_2 = \frac{2}{\sqrt{255}}$$

$$C = \sqrt{c_1^2 + c_2^2} = \frac{32}{\sqrt{255}}, \quad \delta = \arctan \frac{c_2}{c_1} = \frac{1}{16}$$

$$x(t) = \underbrace{\frac{32}{\sqrt{255}}}_{\neq 0} \cdot \underbrace{e^{-\frac{1}{16}t}}_{\neq 0} \cdot \underbrace{\cos\left(\frac{\sqrt{255}}{16} t - \frac{1}{16}\right)}_{=0} \stackrel{?}{=} 0$$

$$\frac{\sqrt{255}}{16} t - \frac{1}{16} = \frac{\pi}{2} \Rightarrow t = 1.63655$$