No
Date

Getaran Mekanik.
Tugas 4

0) Diketahui:

$m = 4{,}6 \times 10^{-12}$ kg

$K = 0{,}380$ N/m

$c = 4{,}93 \times 10^{-7}$ Ns/m

$v_0 = 30$ m/s

$x_0 = 0$ m

a. natural frequency (ω_n) & critical damping (C_c).

$$\omega_n = \sqrt{\frac{k}{m}}$$

$$\omega_n = \sqrt{\frac{0{,}380 \text{ N/m}}{4{,}6 \times 10^{-12} \text{ kg}}}$$

$$\omega_n = \sqrt{8{,}260869565 \times 10^{10}}$$

$$\omega_n = 9{,}088 \times 10^{5} \text{ rad/s}$$

$$C_c = 2\sqrt{mk}$$

$$C_c = 2\sqrt{(4{,}6 \times 10^{-12} \text{ kg})(0{,}380 \text{ N/m})}$$

$$C_c = 2\sqrt{1{,}748 \times 10^{-12}}$$

$$C_c = 2{,}095 \times 10^{-6} \text{ Ns/m}$$

b. Damping ratio (ζ)

$$\zeta = \frac{c}{2\sqrt{mk}}$$

$$\zeta = \frac{4{,}93 \times 10^{-7} \text{ Ns/m}}{2(9{,}088 \times 10^{5}) \text{ rad/s}}$$

$$\zeta = \frac{4{,}93 \times 10^{-7}}{1{,}8176 \times 10^{6}}$$

$$\zeta = 2{,}71 \times 10^{-13}.$$

c. the frequency of damped ossillation:

$$\omega_d = \sqrt{\omega_n^2 - \zeta^2}$$

$$= \sqrt{(9{,}088 \times 10^5)^2 - (2{,}71 \times 10^{-13})^2}$$

$$= \sqrt{8{,}26744 \times 10^{11}}$$

$$= 9{,}091 \times 10^5 \text{ rad/s}$$

d. the response of the accelerometer.

$$x(t) = e^{-\zeta\omega_n t}(A\cos(\omega_d t) + B\sin(\omega_d t)).$$

At $t=0$, $x(0) = 0$

At $t=0$, $v(0) = 30$ m/s

$$x(0) = e^{-\zeta\omega_n \times 0}(A\cos(\omega_d \times 0) + B\sin(\omega_d \times 0)) = 0$$

$$= A\cos(0) + B\sin(0) = 0$$

$$= A = 0$$

$$v(0) = -\zeta\omega_n A e^{-\zeta\omega_n \times 0}\sin(\omega_d \times 0) + \omega_d B e^{-\zeta\omega_n \times 0}\cos(\omega_d \times 0) = 30$$

$$= 0 + \omega_d B = 30$$

$$= B = \frac{30}{\omega_d}$$

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find B =

$$B = \frac{30}{9{,}091 \times 10^5}$$

$$B = 3{,}301 \times 10^{-5} \text{ m/s.}$$

So, $x(t) = e^{-\xi\omega_n t}\left(0\cos(\omega_d t) + (3{,}301 \times 10^{-5})\sin(\omega_d t)\right)$.

e. Value displacement at $t = 1\,\mu s$.

$$x(1\mu s) = e^{-\xi\omega_n(1\mu s)}\left(0\cos(\omega_d(1\mu s)) + (3{,}301 \times 10^{-5})\sin(\omega_d(1\mu s))\right)$$