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2.67 Unbalanced machine seperti gambar.

Mass → 120 kg
amount stiffness → 800 kN/m
damping value → 500 kg/s
Out of balance → 374 W
at running speed → 3000 rev/min

a) Amplitude karena out of balance

$\omega_r = \frac{F_0}{M_0 e}$

$M = 120$ $F_0 = 374$
$C = 500$
$k = 800\,000$
$\omega_r = 100\pi$

$\omega_n = \sqrt{\frac{k}{M}}$ $\zeta = \frac{C}{2\sqrt{km}}$ $k = 8.10^5$

$r = \frac{\omega_r}{\omega_n}$ $\omega_n = 81{,}65$ $r = 3{,}848$ $\zeta = 0{,}026$

$X = \frac{F_0}{\omega_r^2 . M} \frac{r^2}{\sqrt{(1-r^2)^2 + (2.\zeta.r)^2}}$ $X = 3{,}386 . 10^{-5}$

b) $F_0 = M_0 e \omega_r^2$

$e = \frac{F_0}{\omega_r^2 (0{,}01\ m)}$

$e = 3{,}158\ 10^{-3}$

2.68 Plot response 2.67

$M = 120 \quad K = 120 \quad C = 500 \quad F_0 = 314$

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

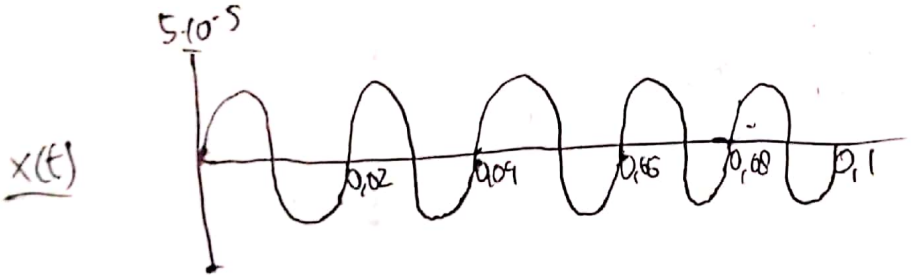
$\omega_r = \frac{300\,24}{60}$

$r = \frac{\omega_r}{\omega_n} \qquad \zeta = \frac{C}{2\sqrt{mk}}$

$$X = \frac{f_0}{\omega_r^2 \cdot m} \cdot \frac{r^2}{\sqrt{(1-r^2)^2 + (2\zeta r)^2}}$$

$$\theta = a\tan\left(\frac{2\cdot\zeta r}{1-r^2}\right)$$

$$x(t) = X \sin(\omega_r t - \theta)$$



2.61 Diket: $m = 50\,kg$ $e = 0.1\,m$ $\omega_0 = 7.5\,Hz$

$m_0 = 5$ $\zeta = 0.06$ $\omega_r = 30\,Hz$

$r = \frac{\omega_r}{\omega_n} = 4$

Dit: Amplitudo

Jawab:

$$X = \frac{m_0 e}{m} \frac{r^2}{\sqrt{(1-r^2)^2 + (2\zeta r)^2}} = \frac{(5)(0.1)}{50} \frac{4}{\sqrt{}}$$

$$X = \frac{(5)(0.1)}{50} \frac{4^2}{\sqrt{(1-4^2)^2 + [2(0.06)(4)]^2}}$$

$X = 0.011\,m$

$X = 1.1\,cm$

Dipindai dengan CamScanner

2.62 Diket- $X = 1mm$ Fixed

$X = 10mm$

Dit- ζ / Damping ratio

Jawab- $X = \frac{m_o e}{m} \frac{r^2}{\sqrt{(1-r^2)^2 + (2\zeta r)^2}}$

at resonance $X = 10mm = \frac{m_o e}{m} \frac{1}{2\zeta}$

$\frac{10m}{m_o e} = \frac{1}{2\zeta}$

when r is very large, $\frac{m}{m_o e}$ and $\lambda = 1mm$

$\frac{m}{m_o e} = 1$

therefore, $10(1) = \frac{1}{2\zeta}$

$\zeta = 0.05$

Dipindai dengan CamScanner

2-63 Diket:- $m_0 = 12$ kg

$m = 100$ kg

$k = 3000$ N/m

$e = 0,1$

$\omega_r = 1800$ rpm $= 188.50$ rad/s

Dit:- Amplitudo of Mass Vibration

Jawab:-

$\omega_0 = \sqrt{(3000/100)} = 5.9772$ rad/s

$r = \frac{\omega_r}{\omega_0} = \frac{188.50}{5.9772} = 31.545$ m

$X = \left(\frac{m_0 e}{m}\right)\left(\frac{r^2}{|1-r^2|}\right) = 0.01201$

2.69)

$x = 0,05\ m$ $\quad m = 10\ kg$

$\zeta = 0,1$

$e = 0,1\ m$

$k = 3200\ N/m$

$$r = \frac{\frac{2\pi \times 1800}{60}}{\sqrt{3000/100}} = 2\pi\sqrt{30} = 34,414$$

Rotation unbalance

$$e = \left(\frac{mx}{m_0}\right)\frac{\sqrt{(1-r^2)^2+(2\zeta)^2}}{r^2} = \frac{10 \times 0,05 \times \sqrt{(1-(34,414)^2)^2+(2\times 0,1\times 34,414)^2}}{(34,414)^2}$$

$$= \boxed{0,49950\ m}$$

2.65)

$$m\ddot{x} + c\dot{x} + kx = m_0 e\omega^2 \sin(\omega t + \theta)$$

- Steady state solution

$$x(t) = \frac{m_0 e}{m} \frac{r^2}{\sqrt{(1-r^2)^2 + (2\zeta r)^2}} \sin \omega t$$

- Force transmitted to the ground

$$F(t) = kx + c\dot{x} = \frac{m_0 e}{m} \frac{kr^2}{\sqrt{(1-r^2)^2 + (2\zeta r)^2}} \sin \omega t + \frac{m_0 e}{m} \frac{c\omega r^2}{\sqrt{(1-r^2)^2 + (2\zeta r)^2}} \cos \omega t$$

- Magnitude of the force transmitted

$$F_0 = \frac{m_0 e}{m} \frac{r^2 \sqrt{k^2 + c^2\omega^2}}{\sqrt{(1-r^2)^2 + (2\zeta r)^2}} = m_0 e\omega \frac{\sqrt{1 + (2\zeta r)^2}}{\sqrt{(1-r^2)^2 + (2\zeta r)^2}}$$

- Magnitude of the force generated by the rotating mass

$$F_r = m_0 e\omega^2$$

- $F_0 = 0{,}1\, F_r$

$$\Rightarrow m_0 e\omega^2 \frac{\sqrt{1 + (2\zeta r)^2}}{\sqrt{(1-r^2)^2 + (2\zeta r)^2}} = 0{,}1\, m_0 e\omega^2$$

- $\zeta = 0{,}2$

$$\Rightarrow r^4 - 17{,}84 r^2 - 99 = 0$$

$$\Rightarrow r^2 = 22{,}28 = \frac{\omega^2}{k/m} \Rightarrow \frac{k}{m} = \left(\frac{10000 \times 2\pi}{60}\right)^2 \frac{1}{22{,}28}$$

$$\Rightarrow k = 95 \left(\frac{10000 \times 2\pi}{60}\right)^2 \frac{1}{22{,}28} = \boxed{2{,}21 \times 10^6 \text{ N/m}}$$

2-66)

$$X_m(\zeta, r) = \frac{r^2}{\sqrt{(1-r^2)^2 + (2\zeta r)^2}}$$