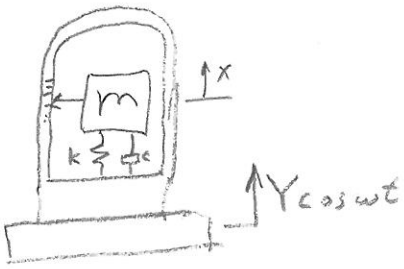
~~69~~ 71

Problem 2.~~59~~ 61

Given: Accelerometer

$m = 0.04\ kg$

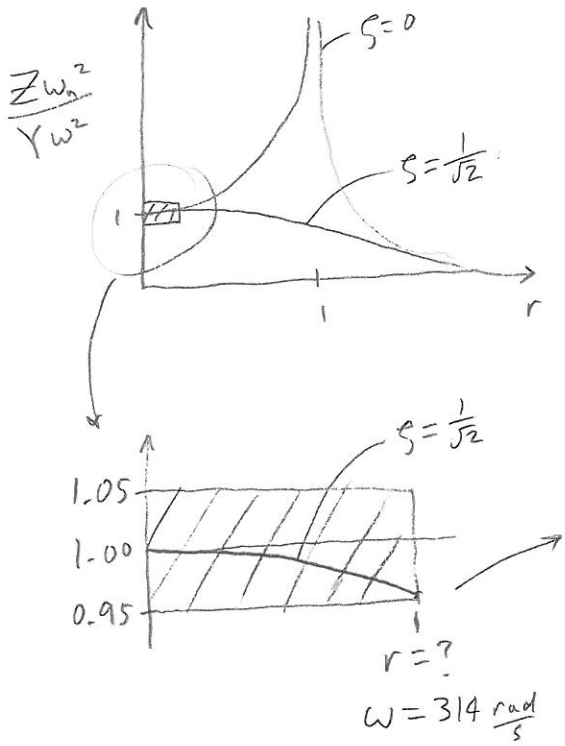
[max correction error 5%
i.e. $0.95 \le \frac{Z\omega_n^2}{\omega^2 Y} \le 1.05$



[Freq. range
0 – 50 Hz
i.e. $0 \le \omega \le 314 \frac{rad}{s}$ ($50 \times 2\pi$)

Find: k, c

Solution: Start with $\zeta = \frac{1}{\sqrt{2}}$ for best performance, regardless of r.



$$\frac{Z\omega_n^2}{\omega^2 Y} = \frac{1}{\sqrt{(1-r^2)^2 + (2\zeta r)^2}}$$

$$0.95 = \frac{1}{\sqrt{(1-r^2)^2 + (2\frac{1}{\sqrt{2}} r)^2}}$$

$$1 - 2r^2 + r^4 + 2r^2 = \frac{1}{0.95^2}$$

$$r = \sqrt[4]{\frac{1}{0.95^2} - 1} = 0.5733$$

$$r = \frac{\omega}{\omega_n}$$

$$0.5733 = \frac{314}{\omega_n} \rightarrow \omega_n = 547.97\ rad/s$$

$$\omega_n = \sqrt{\frac{k}{m}} \rightarrow 547.97 = \sqrt{\frac{k}{0.4}} \rightarrow \boxed{k = 120 \times 10^3\ N/m}$$

$$\zeta = \frac{c}{2m\omega_n} \rightarrow \frac{1}{\sqrt{2}} = \frac{c}{2 \times 0.04 \times 547.97} \rightarrow \boxed{c = 31.0\ \frac{N \cdot s}{m}}$$

Homework 2.~~61~~ 71