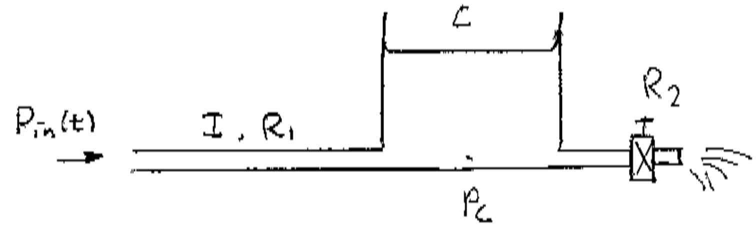


$R_1 = 0$

$P_c(t) = \bar{P}_c + \Delta P_c(t)$, $P_{in}(t) = \bar{P}_{in} + \Delta P_{in}(t)$

$\dfrac{\Delta P_c(t)}{\Delta P_{in}(t)}$ is governed by $H(s) = \dfrac{1}{CI\, s^2 + s\,(I/R_2) + 1}$

(a) <u>Frequency Response Function</u>

$$G(\omega) = \frac{1}{(1 - CI\omega^2) + j\omega\,(I/R_2)}$$

(b) Natural frequency. $\omega_n = \sqrt{\dfrac{1}{C \cdot I}}$

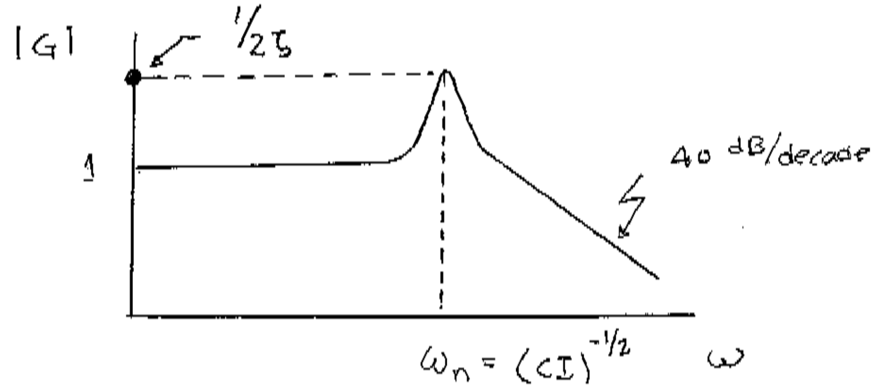
damping factor: $\zeta = \dfrac{I/R_2}{2\,CI \cdot \omega_n} = \dfrac{1}{2\,(R_2 C)\cdot \omega_n}$

$\omega \to 0, \quad G(\omega) \to 1$

$\omega \to \infty, \quad G(\omega) \to -\dfrac{1}{CI\omega^2}$

$\omega \to \omega_n, \quad G(\omega) \to \dfrac{1}{j\,\omega_n (I/R_2)} = \dfrac{1}{2j\,\omega_n^2\, CI\zeta} = \dfrac{1}{2\zeta j}$

(c)



(d) $\Delta P_{in}(t)$ has a noise component at 200 rad/s

$$I = 100 \ \frac{N \cdot s^2}{m}$$

Company A $\Rightarrow$ Does NOT want to see this component

$$\Rightarrow \quad \omega_n \ll 200 \quad \text{OR} \quad \frac{1}{\sqrt{C(100)}} \ll 200$$

$$100C \gg \frac{1}{4 \times 10^4} \quad \Rightarrow \quad C \gg 0.25 \times 10^{-6}$$

(e) If noise occurs at frequency ω_n

$\Rightarrow$ $\Delta P_{in}(t)$ will fluctuate significantly,

fluid level in tank C will rise and fall quickly.

can change R_2 to calm this down. If $R_2 \downarrow$,

$\zeta \uparrow$, the response is smaller at resonance.