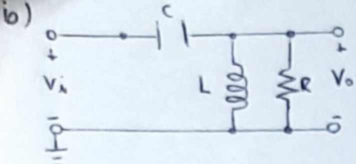
b)



$$H(s) = \frac{V_o(s)}{V_i(s)} = \frac{\frac{S.RL}{R+SL}}{\frac{SRL}{R+SL} + \frac{1}{SC}} = \frac{1}{1 + \frac{R+SL}{s^2 RLC}} = \frac{1}{1 + \frac{1}{s^2 LC} + \frac{1}{sRC}} = \circledast$$

$$\frac{1}{Z_{eq}} = \frac{1}{Z_R} + \frac{1}{Z_L} = \frac{1}{R} + \frac{1}{S.L} = \frac{R+SL}{RSL}$$

$$Z_{eq} = \frac{RSL}{R+LS}$$

$$\circledast \quad \frac{s^2}{s^2 + \frac{1}{LC} + \frac{s}{RC}}$$

Con $\omega_o^2 = \frac{1}{LC}$ y $\frac{\omega_o}{Q} = \frac{1}{RC}$, luego

$$\boxed{H(s) = \frac{s^2}{s^2 + \omega_o^2 + s\frac{\omega_o}{Q}}}$$

Con $s = j\omega \Rightarrow H(j\omega) = \dfrac{-\omega^2}{\omega_o^2 - \omega^2 + j\omega\frac{\omega_o}{Q}}$

$$\boxed{|H(j\omega)| = \frac{\omega^2}{\sqrt{(\omega_o^2-\omega^2)^2 + \left(\frac{\omega\omega_o}{Q}\right)^2}}}$$

↓

respuesta en módulo

→ $|H(\omega \to 0)| \approx \dfrac{\omega^2}{\omega_o^2}$ → Comporta como ω^2 ⇒ a baja frecuencia, en dB, se tiene $40.\log(\omega)$ ⇒ comportamiento lineal con pendiente $+40\ \frac{dB}{década}$

→ $|H(\omega \to +\infty)| \approx \dfrac{\omega^2}{\omega^2} = 1$ ⇒ Al pasar a dB $(20.\log(1)) = 0$

→ $|H(\omega = \omega_o)| = \dfrac{\omega_o^2}{\omega_o^2/Q} = Q$

$$\boxed{\angle H(j\omega) = \angle P(j\omega) - \angle Q(j\omega) = \pi - \text{arctg}\left(\frac{\frac{\omega.\omega_o}{Q}}{\omega_o^2 - \omega^2}\right)}$$ → Respuesta de fase

$\angle P(j\omega) = \text{arctg}\left(\frac{Im(P)}{Re(P)}\right)$ ⇒ Como $P(j\omega)$ solo tiene parte real y negativa ⇒ $\angle P(j\omega) = \pi$

$\angle Q(j\omega) = \text{arctg}\left(\dfrac{\omega\omega_o/Q}{\omega_o^2 - \omega^2}\right)$

- Cuando $\omega \to 0$ $(\omega \ll \omega_o)$: $\angle H(j\omega) = \pi - \text{arctg}(0) = \pi$
- Cuando $\omega \to \infty$ $(\omega \gg \omega_o)$: $\angle H(j\omega) = \pi - \underbrace{\text{arctg}\left(-\frac{\omega_o}{Q.\omega}\right)}_{\text{tiende a 0, pero con parte real siempre negativa} \to \text{corrido a } \pi} = \pi - \pi = 0$
- Cuando $\omega = \omega_o$: $\angle H(j\omega) = \pi - \pi/2 = \pi/2$

Tipo de Filtro: Pasa altos de segundo orden

Frecuencia de corte: $|H(j\omega)| = \frac{1}{\sqrt{2}}$

$$\frac{\omega^2}{\sqrt{(\omega_o^2-\omega^2)^2 + \left(\frac{\omega\omega_o}{Q}\right)^2}} = \frac{1}{\sqrt{2}}$$

$$2\omega^4 = (\omega_o^2 - \omega^2)^2 + \left(\frac{\omega\omega_o}{Q}\right)^2$$

$$2\omega^4 = \omega_o^4 - 2\omega_o^2\omega^2 + \omega^4 + \left(\frac{\omega\omega_o}{Q}\right)^2$$

$$\omega^4 + \omega^2\left(2\omega_o^2 - \frac{\omega_o^2}{Q^2}\right) - \omega_o^4 = 0$$

Si $x = \omega^2$,

$$x^2 + x\left(2\omega_o^2 - \frac{\omega_o^2}{Q^2}\right) - \omega_o^4 = 0$$

$$x = \frac{-\left(2\omega_o^2 - \frac{\omega_o^2}{Q^2}\right) \pm \sqrt{\left(2\omega_o^2 - \frac{\omega_o^2}{Q^2}\right)^2 + 4\omega_o^4}}{2} \quad \circledast$$

$$\circledast \quad x = \left[-\omega_o^2\left(2 - \frac{1}{Q^2}\right) \pm \omega_o^2\sqrt{\left(2 - \frac{1}{Q^2}\right)^2 + 4}\right] \cdot \frac{1}{2}$$

$$x = \omega_o^2 . \left[\sqrt{\left(2 - \frac{1}{Q^2}\right)^2 + 4} - 2 + \frac{1}{Q^2}\right] \cdot \frac{1}{2}$$

$$\boxed{\omega = \omega_o\sqrt{\frac{\sqrt{\left(2 - \frac{1}{Q^2}\right)^2 + 4} - 2 + \frac{1}{Q^2}}{2}}}$$ = Frecuencia de corte