

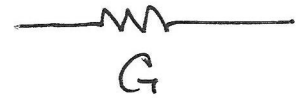
Components

AC Steady-State Analysis

Impedance \Rightarrow Ohm's Law \Leftarrow Admittance, S



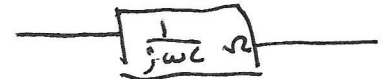
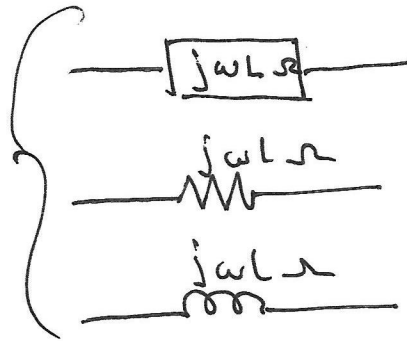
real



conductance, S
real

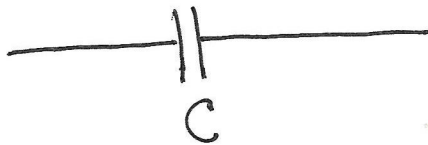


pos.
imag.

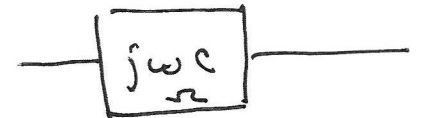
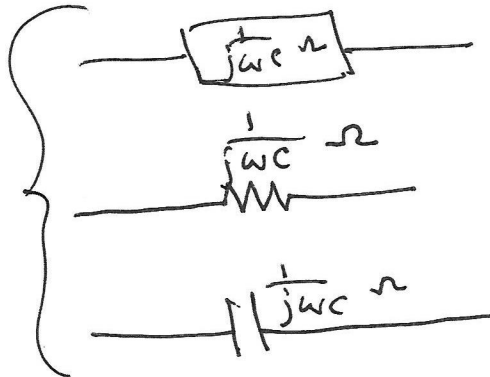


$-j \frac{1}{\omega L}$ S

neg. imag.

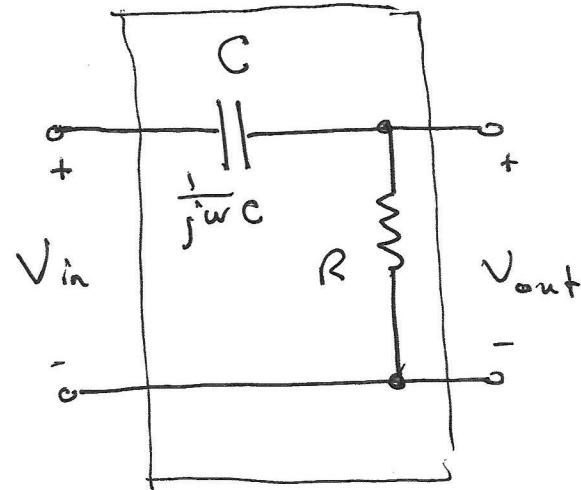


neg.
imag.



pos. imag.

$$\frac{1}{j\omega C} = -j \frac{1}{\omega C}$$



Find the transfer function.

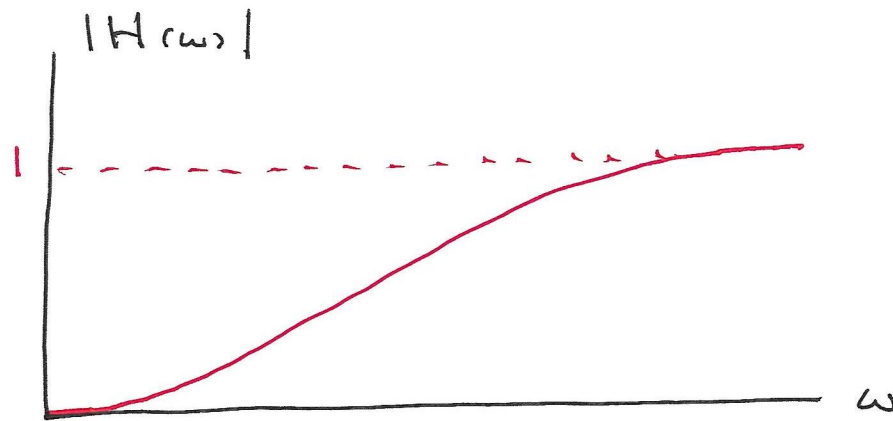
Treat as a voltage divider.

$$\begin{aligned}
 H(\omega) &\triangleq \frac{V_{out}}{V_{in}} = \frac{R}{R + \frac{1}{j\omega C}} \cdot \frac{j\omega C}{j\omega C} \\
 &= \frac{j\omega RC}{j\omega RC + 1}
 \end{aligned}$$

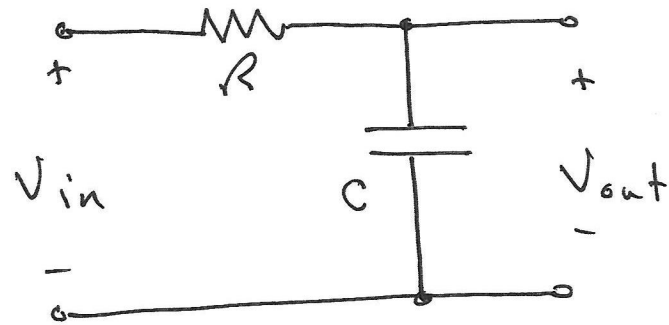
$$|H(\omega)| = \frac{|j\omega RC|}{|j\omega RC + 1|} = \frac{\omega RC}{\sqrt{1^2 + (\omega RC)^2}}$$

$$\lim_{\omega \rightarrow 0} |H(\omega)| = \frac{\omega RC}{1} = \frac{0}{1} = 0$$

$$\lim_{\omega \rightarrow \infty} |H(\omega)| = \frac{\omega RC}{\omega RC} = 1$$



High-Pass Filter



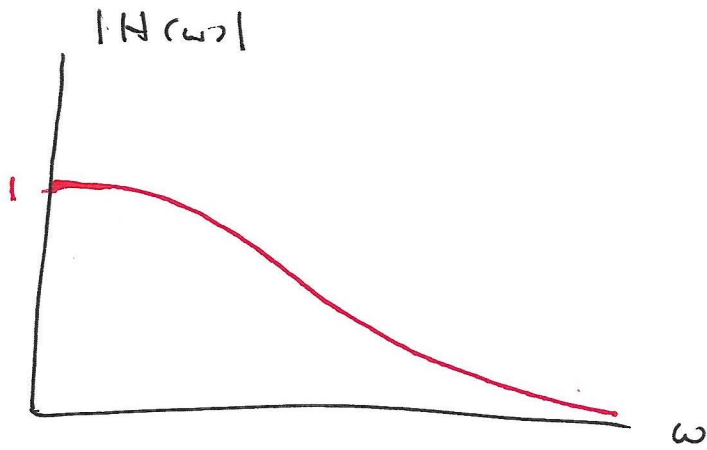
$$H(\omega) = \frac{V_{out}}{V_{in}} = \frac{j\omega C}{R + j\omega C} \cdot \frac{j\omega C}{j\omega C}$$

$$= \frac{1}{1 + j\omega RC}$$

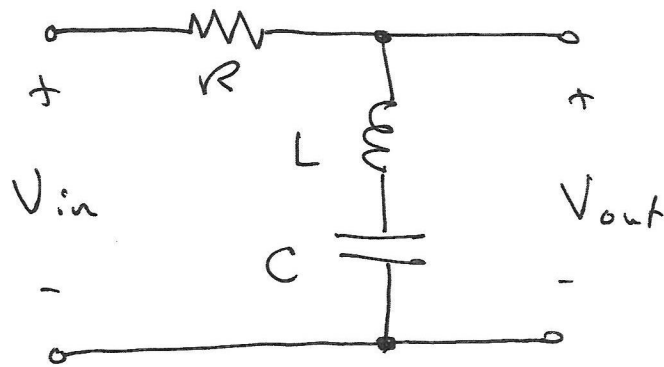
$$|H(\omega)| = \frac{1}{\sqrt{1^2 + (\omega RC)^2}}$$

$$\lim_{\omega \rightarrow 0} |H(\omega)| = 1$$

$$\lim_{\omega \rightarrow \infty} |H(\omega)| \approx \frac{1}{\omega RC} = \textcircled{0}$$



Low-Pass Filter



$$H(\omega) = \frac{V_{out}}{V_{in}} = \frac{j\omega L + \frac{1}{j\omega C}}{R + j\omega L + \frac{1}{j\omega C}} \cdot \frac{j\omega C}{j\omega C}$$

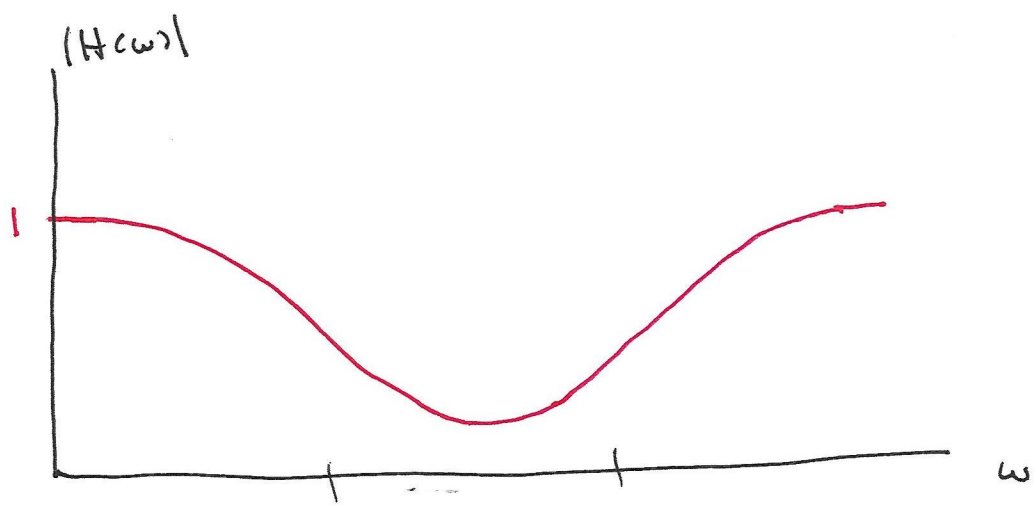
$$= \frac{1 - \omega^2 LC}{1 - \omega^2 LC + j\omega RC}$$

$$|H(\omega)| = \frac{\omega^2 LC}{\omega^2 LC} = 1$$

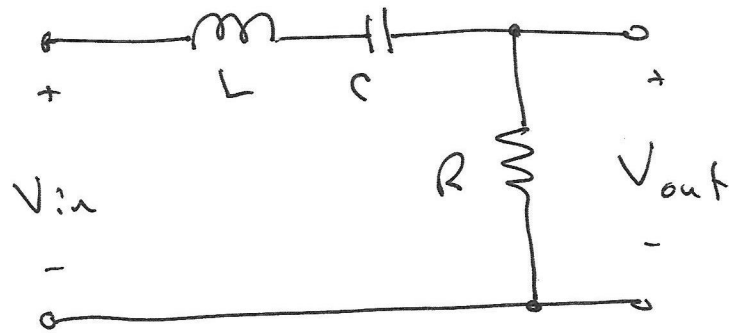
for large ω

$$= \frac{1}{1} = 1$$

for small ω



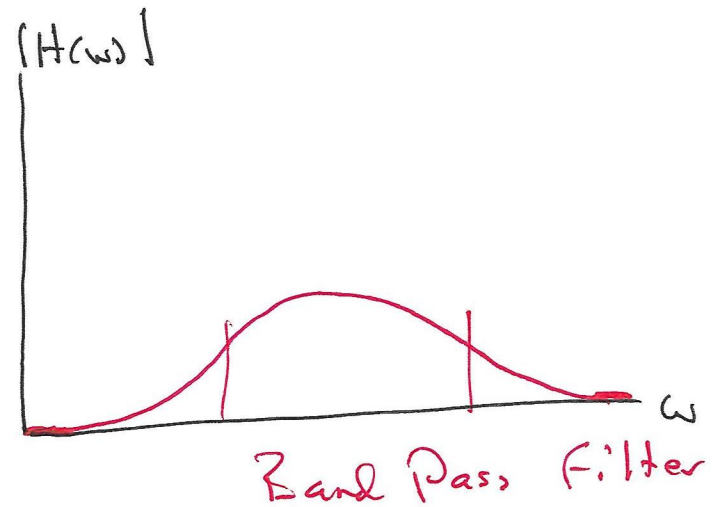
Notch Filter
Band Stop Filter
Band Reject Filter



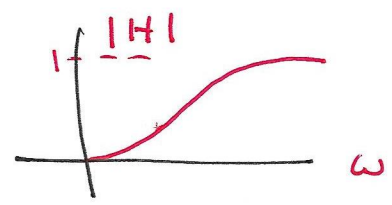
$$H(\omega) = \frac{R}{R + j\omega L + \frac{1}{j\omega C}}$$

$$\lim_{\omega \rightarrow 0} |H(\omega)| = 0$$

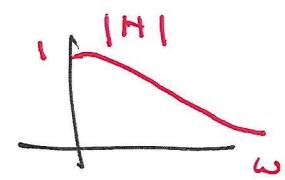
$$\lim_{\omega \rightarrow \infty} |H(\omega)| = 0$$



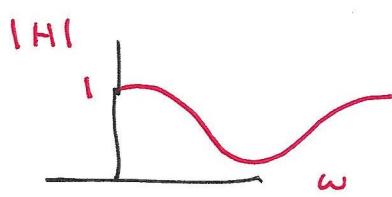
High Pass



Low Pass



Band Stop



Band Pass

