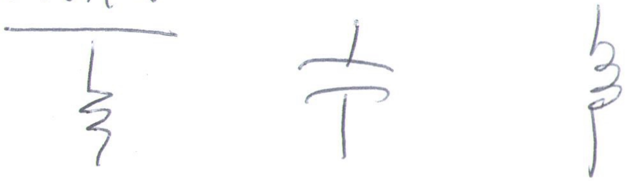
EE16B 19SP W3L1

Review

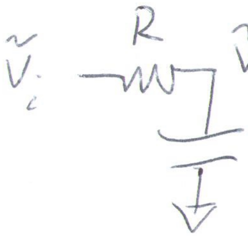


R

$\frac{\tilde{V}}{\tilde{I}} = R$

$Z_C = \frac{\tilde{V}}{\tilde{I}} = \frac{1}{j\omega C}$

$Z_L = j\omega L$



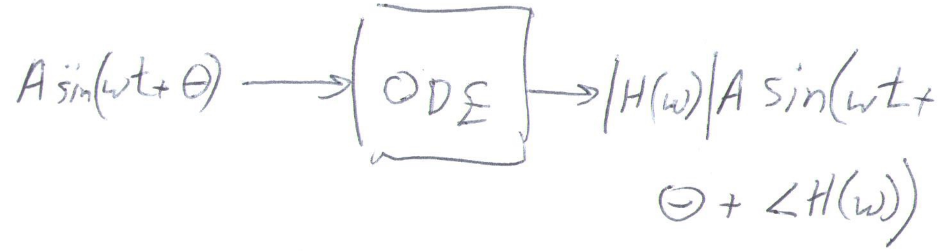
C ~ $Z_C = \frac{1}{j\omega C}$

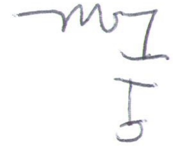
$$H(\omega) = \frac{Z_C}{Z_C + R} = \frac{1}{j\omega C} \frac{1}{\frac{1}{j\omega C} + R} = \frac{1}{1 + j\omega RC} = \frac{1}{1 + j\omega\tau}$$

$\tau = RC$

$\omega_p = \frac{1}{\tau}$

$$H(\omega) = \frac{1}{1 + j\omega/\omega_p}$$



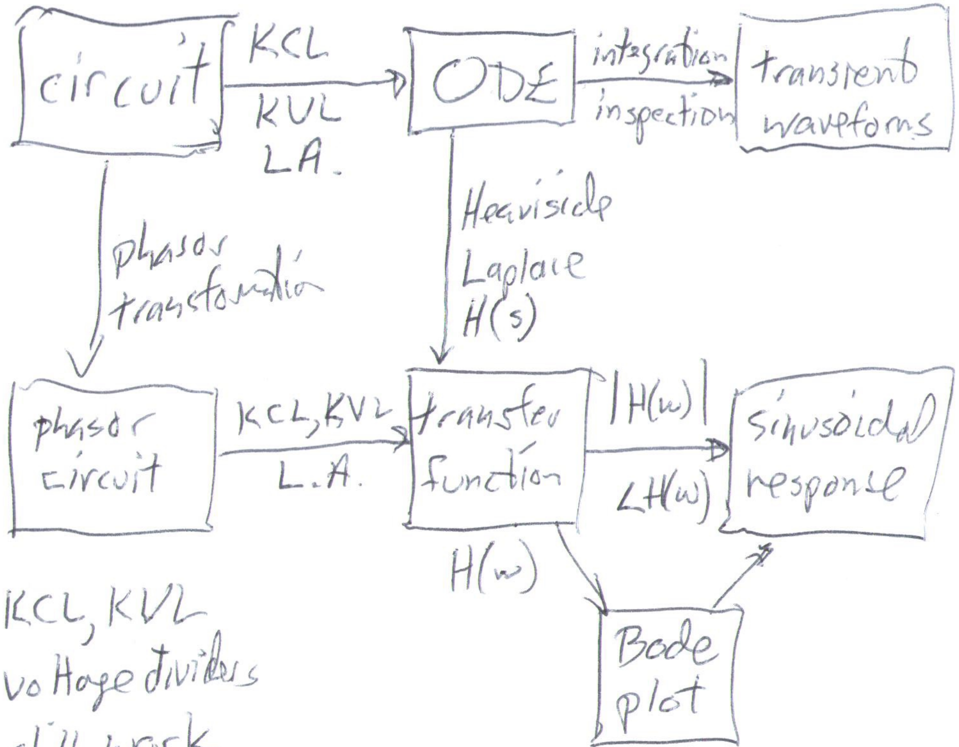


$$H(\omega) = \frac{1}{1 + j\omega/\omega_p}$$

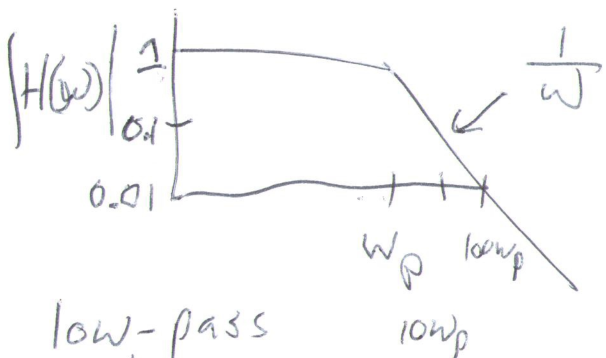
$\omega_p = \frac{1}{\tau}$

$\tau = RC$

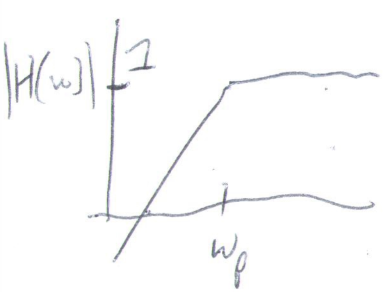
low-pass filter



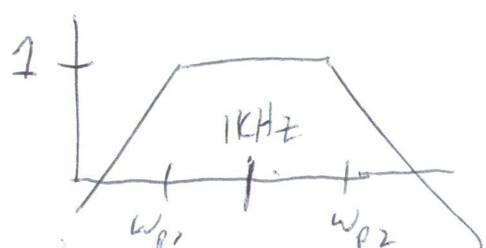
KCL, KVL voltage dividers still work w/ phasors



low-pass filter

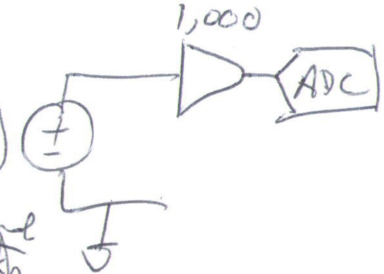


High Pass



60Hz Band pass 100KHz

EX: Sensor



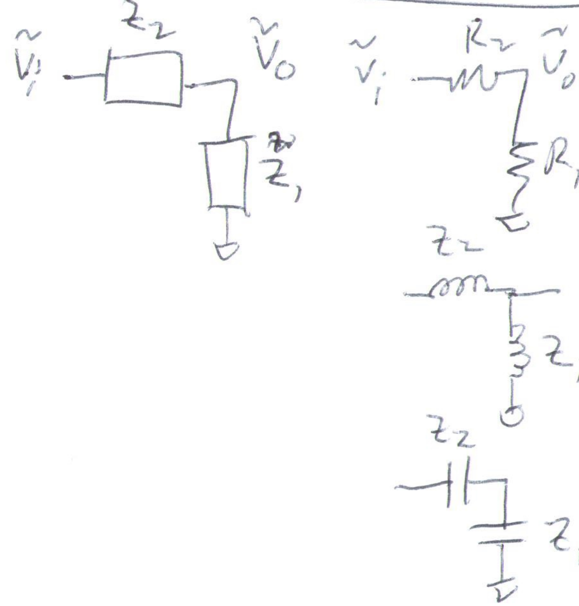
1mV sin(ωt)

$\omega = 10^3$ rad/s

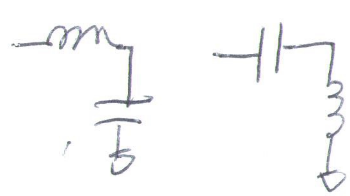
$f = 160$ Hz ≈ 1 KHz

60 Hz noise $(20mV)\sin(2\pi 60t)$

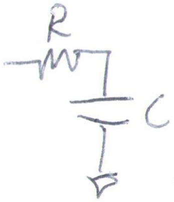
100 kHz noise $(50mV)\sin(10^5 t)$



$$H(\omega) = \frac{R_1}{R_1 + R_2}$$



Thursday



$\tau = RC$

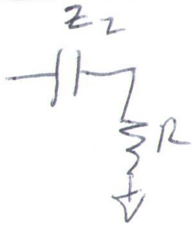
$$H(\omega) = \frac{1}{1+j\omega/\omega_p} = \frac{1}{1+j\omega\tau}$$

$\tau = \frac{L}{R}$

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

$\omega_p = \frac{1}{\tau}$

$$= \frac{1}{1+j\omega\tau} = \frac{1}{1+j\omega/\omega_p}$$



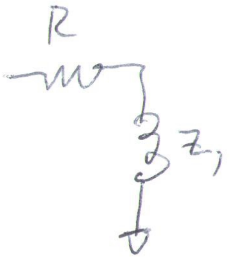
$$H(\omega) = \frac{R}{R+\frac{1}{j\omega C}} = \frac{j\omega RC}{1+j\omega RC}$$

$\tau = RC$

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

$\omega_p = \frac{1}{\tau}$

$$H(\omega) = \frac{j\omega/\omega_p}{1+j\omega/\omega_p}$$



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

$\tau = \frac{L}{R}$

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

$\omega_p = \frac{1}{\tau}$

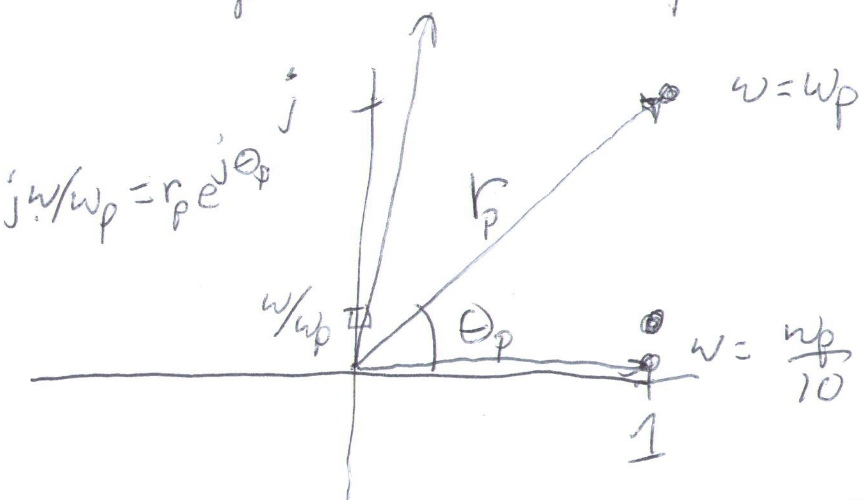
$$H(\omega) = \frac{j\omega/\omega_p}{1+j\omega/\omega_p}$$

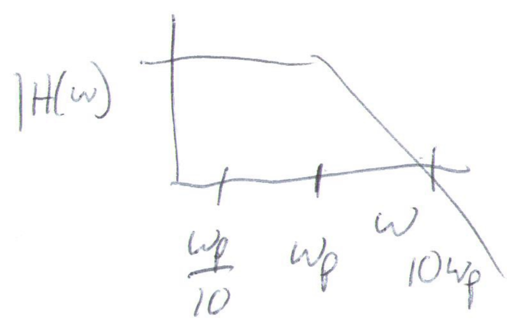
$$H(\omega) = \frac{1}{1+j\omega/\omega_p} = \frac{r_1 e^{j\theta_1}}{r_p e^{j\theta_p}} = \frac{1\, e^{j0}}{r_p e^{j\theta_p}}$$

$$= |H(\omega)|\, e^{j\angle H(\omega)} = \frac{1}{r_p}\, e^{j(0-\theta_p)}$$

$$H(\omega) = \frac{1}{r_p} \qquad \angle H(\omega) = -\theta_p$$

$$1 + j\omega/\omega_p = r_p e^{j\theta_p}$$



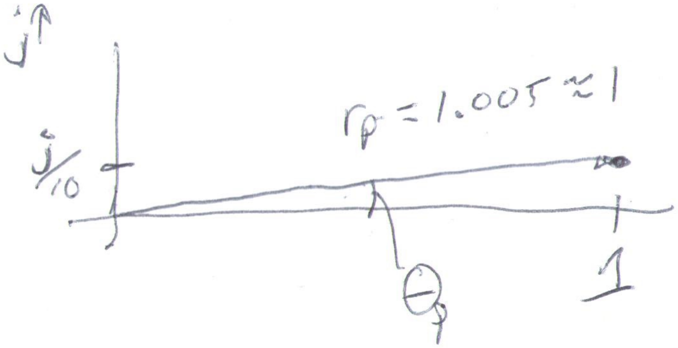


$\omega = \omega_p$

$r_p = \sqrt{2}$

$\theta_p = \frac{\pi}{4}, 45^\circ$

$\omega = \dfrac{\omega_p}{10}$



$1 + j\,\omega/\omega_p$

$1 + \dfrac{j}{10}$

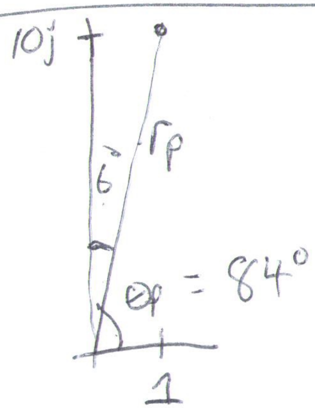
$\theta_p \approx \dfrac{\omega/\omega_p}{1} = 0.1$ rad

6°

$\omega = 10\,\omega_p$

$1 + j\dfrac{\omega}{\omega_p}$

$1 + 10j$



$|1 + j\,\omega/\omega_p|$

$\angle(1 + j\,\omega/\omega_p)$

$$|H(\omega)| \approx \begin{cases} 1 & \omega = \dfrac{\omega_p}{10} \\ \dfrac{1}{\sqrt{2}} & \omega = \omega_p \\ 0.1 & \omega = 10\,\omega_p \end{cases}$$

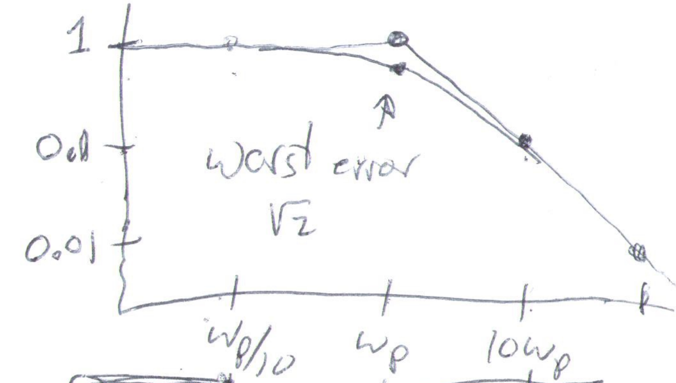
$\dfrac{1}{r_p}$

$$\angle H(\omega) = \begin{cases} -6^\circ & \omega = \dfrac{\omega_p}{10} \\ -45^\circ & \omega = \omega_p \\ -84^\circ & \omega = 10\,\omega_p \end{cases}$$

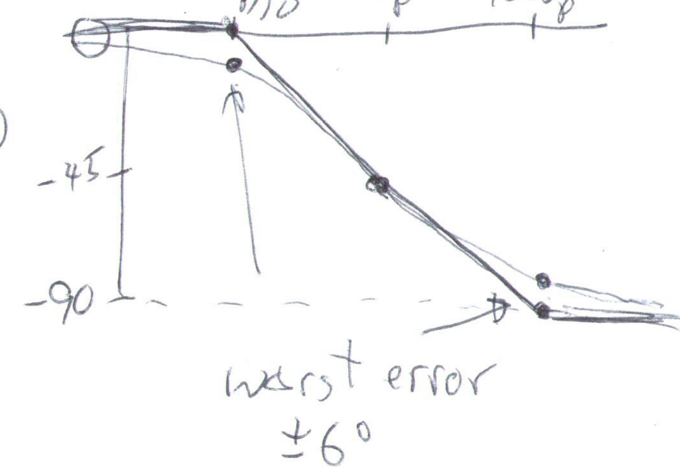
$-\theta_p$

$H(\omega) = \dfrac{1}{1 + j\omega/\omega_p}$

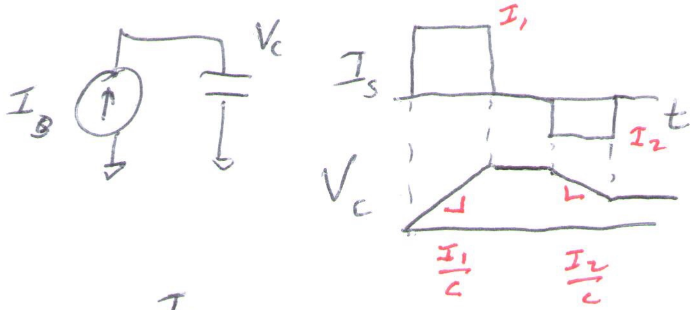
$|H(\omega)|$

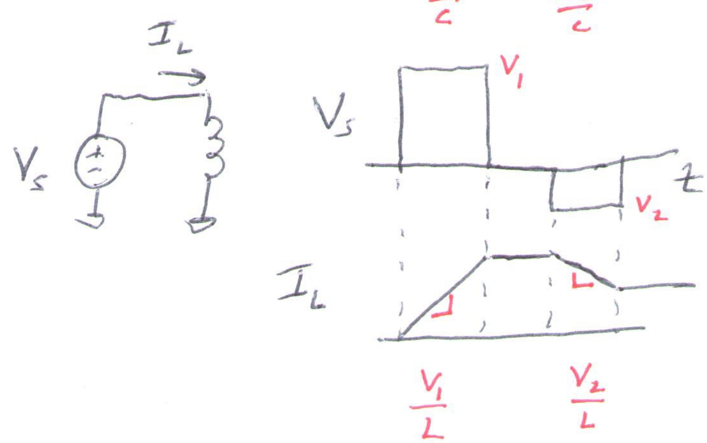


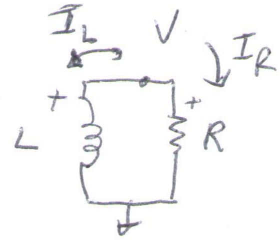
$\angle H(\omega)$



Waveforms (transient)







$$V = L\frac{dI_L}{dt}$$

$$V = I_R R = -I_L R$$

$$L\frac{dI_L}{dt} = -I_L R$$

$$\frac{d}{dt} I_L = -\frac{R}{L} I_L$$

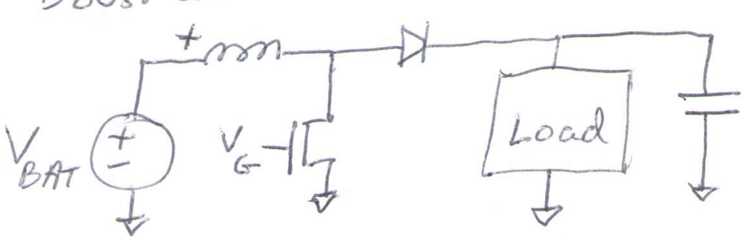
$$\tau = \frac{L}{R} \qquad \frac{d}{dt} I_L = \frac{-I_L}{\tau}$$

$$I(t) = I_0 e^{-t/\tau} \qquad \tau = \frac{L}{R}$$

Recall

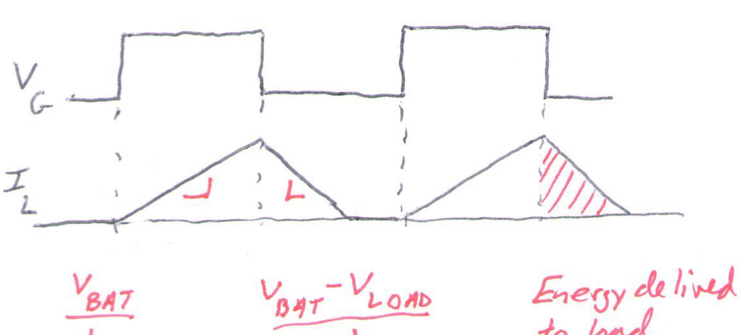
$$V(t) = V_0 e^{-t/\tau} \qquad \tau = RC$$

Boost Converter



0.8–1.6V

wants 5V (say)



DC analysis – sources are constant
I, V constant

$I = C\frac{dV}{dt} = 0 \qquad I = 0 \Rightarrow$ open

$V = L\frac{dI}{dt} = 0 \qquad V = 0 \Rightarrow$ short

transient – anything goes, find $V(t)$, $I(t)$

steady state – sinusoidal inputs
find sinusoidal response after any non-sinusoidal transients