Note Title 2/26/2018

EE 307

02/26/18

$$a_3 \frac{d^3 v_o}{dt^3} + a_2 \frac{d^2 v_o}{dt^2} + a_1 \frac{d v_o}{dt} + a_0 v_o = b_2 \frac{d^2 v_i}{dt^2} + b_1 \frac{d v_i}{dt} + b_0 v_i$$

a_i & b_i constant

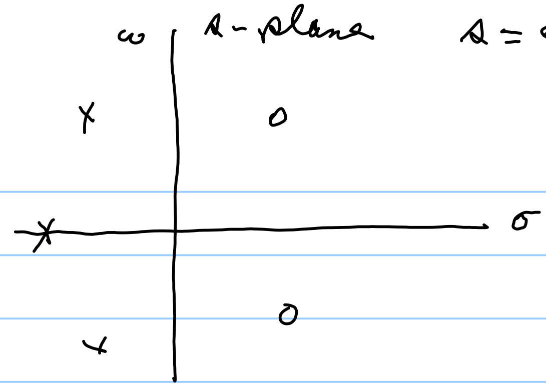
if $-\infty < t < \infty$, then $\underset{v_i(t)}{\underset{\shortparallel}{V_i e^{st}}}$ leads to $\underset{v_o(t)}{\underset{\shortparallel}{V_o e^{st}}}$, V_i, V_o, s complex #'s

$$\left(a_3 s^3 V_o + a_2 s^2 V_o + a_1 s V_o + a_0 V_o\right) e^{st} = \left(b_2 V_i s^2 + b_1 s V_i + b_0 V_i\right) e^{st}$$

cancel e^{st} as an entire function ($\neq 0$ ever)

$$\frac{V_o}{V_i} = T(s) = \frac{b_2 s^2 + b_1 s + b_0}{a_3 s^3 + a_2 s^2 + a_1 s + a_0} \Rightarrow \text{transfer function}$$

$s \Rightarrow$ a complex variable $\quad T(s) = \dfrac{b_2 (s - z_1)(s - z_2)}{a_3 (s - p_1)(s - p_2)(s - p_3)} \Rightarrow \dfrac{\text{zeros}}{\text{poles}}$



$s = \sigma + j\omega$

other meanings of s
Laplace transforms
derivative operator

desire response to other than e^{st}, for example $v_i(t) = \delta(t)$
= unit impulse

given $v_i(t) = \delta(t)$, $v_o = h(t)$

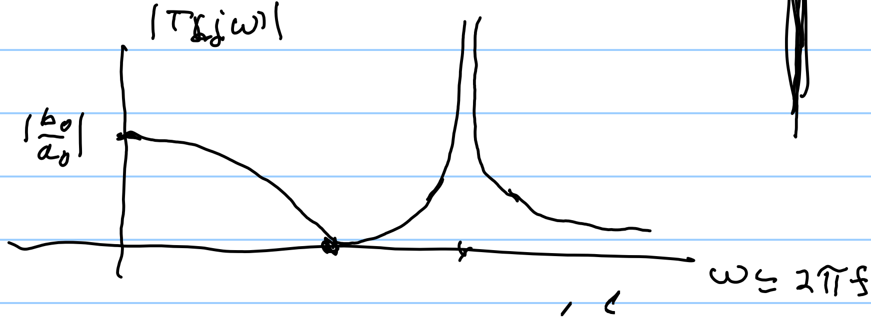
$$v_o(t) = \int_{-\infty}^{\infty} h(t-\tau)\, v_i(\tau)\, d\tau \Rightarrow \text{convolution}$$

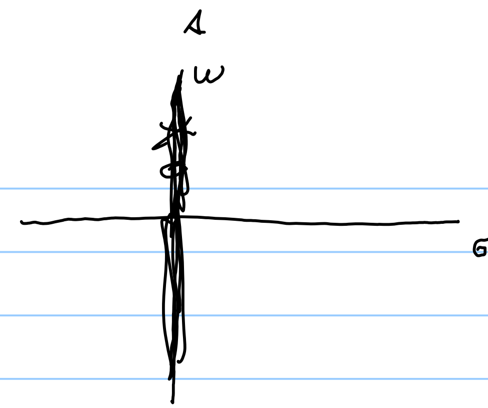
note $\dfrac{d\,1(t)}{dt} = \delta(t)$, $\quad 1(t) = \begin{cases} 1 & t>0 \\ 0 & t<0 \end{cases}$

in the lab can put $v_i = 1(t)$, $\dfrac{dv_i}{dt}$ is then $\delta(t)$

$$v_o = \frac{dh(t)}{dt}$$

$$T(s)\Big|_{s=j\omega} = |T(j\omega)|\, e^{j\angle T(j\omega)}$$





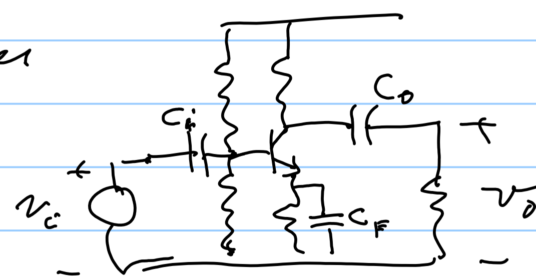
$$\omega \rightarrow e^{st}\Big|_{s=j\omega} \Rightarrow e^{j\omega t} \cdot |\cdot|$$

$$= (\cos\omega t + j\sin\omega t)\,|T(j\omega)|$$

plots $\Leftarrow$ $|T(j\omega)|$

For our amplifier

$$T(s) = \frac{s^2 (s - z_E)\, T(\infty)}{(s-p_1)(s-p_2)(s-p_3)}$$



$$z_c = \frac{1}{sC}$$

$$s = j\omega \Rightarrow \frac{1}{j\omega C} \Rightarrow |z_c(j\omega)| = \frac{1}{|\omega C|}$$

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