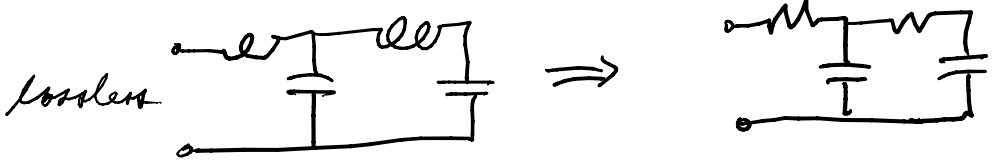
12/05/07
EE610

RC synthesis

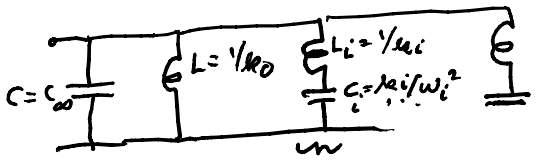


$$y_{LC}(s) = C_\infty s + \frac{k_0}{s} + \sum_{i=1}^{n} \frac{k_i s}{s^2 + \omega_i^2}$$

$\delta[y(s)] = 2n+2$ if all coefficients $\neq 0$

$C_\infty \geq 0,\ k_0 \geq 0,\ k_i \geq 0$

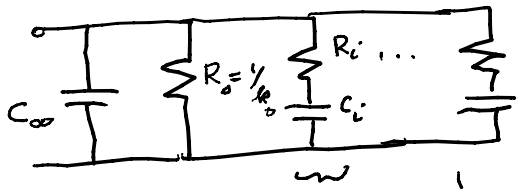
if passive $\Rightarrow y$ is PR



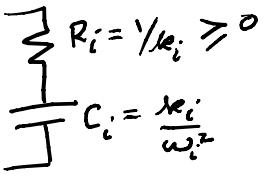
$$y_i(s) = \frac{k_i s}{s^2 + \omega_i^2} = \frac{1}{\frac{s}{k_i} + \frac{\omega_i^2}{k_i s}}$$

$$y_{LC}(s) = -y_{LC}(-s) = s\left[C_\infty + \frac{k_{e0}}{s^2} + \sum_{i=1}^{n} \frac{k_i}{s^2 + \omega_i^2}\right] = s f(s^2)$$

$\Rightarrow$ RC



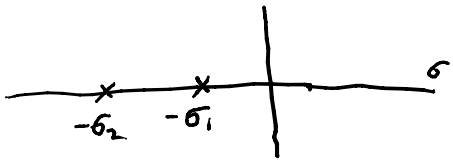
$$y_{i_{RC}} = \frac{1}{\frac{1}{k_i} + \frac{\omega_i^2}{k_i s}} \Rightarrow$$



$$y_{RC}(s) = C_\infty s + g_0 + \sum_{i=1}^{n} \frac{k_i s}{s + \omega_i^2}$$

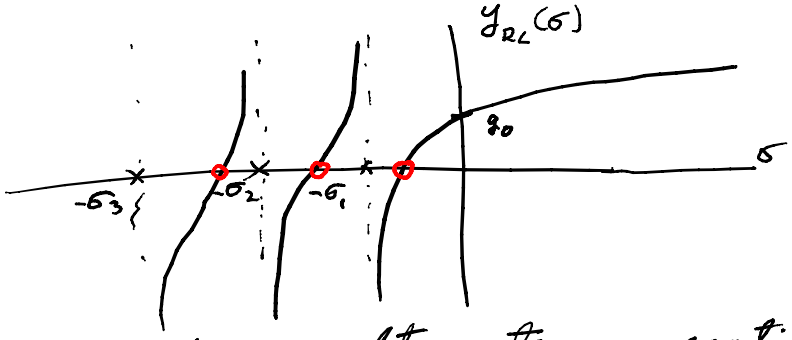
$\omega_i^2 = \sigma_i \geq 0,\ k_i > 0$

$$s \cdot f(s) = k_\infty s + g_0 + \sum_{i=1}^{n} \frac{k_i s}{s + \sigma_i}$$



$$\frac{d\, y_{RC}(\sigma)}{d\sigma} = k_\infty + \sum_{i=1}^{n}\left[\frac{k_i}{\sigma + \sigma_i} - \frac{k_i \sigma}{(\sigma+\sigma_i)^2}\right] = k_\infty + \sum_{i=1}^{n}\left[\frac{\sigma_i k_i}{(\sigma+\sigma_i)^2}\right] > 0$$

as $\sigma_i > 0$, $k_i > 0$



$\therefore$ poles and zeros alternate on negative real axis

Ex: $y_{RC}(s) = k \dfrac{(s+1)(s+3)}{(s+2)(s+4)}$, $k>0$ to make y_{RC} PR

$k = \frac{5}{1}$

$$\frac{y_{RC}(s)}{s} = \frac{5}{s}\left(\frac{(s+1)(s+3)}{(s+2)(s+4)}\right) = \frac{\frac{5\times3}{2\times4}}{s} + \frac{\frac{5(-1)(1)}{(-2)(2)}}{s+2} + \frac{\frac{5}{-4}\frac{(-3)(-1)}{(-2)}}{s+4}$$

$$y_{RC}(s) = \frac{15}{8} + \frac{(5/4)s}{s+2} + \frac{(15/8)s}{s+4} = \frac{15}{8} + \frac{1}{\frac{4}{5}+\frac{8}{5s}} + \frac{1}{\frac{8}{15}+\frac{32}{15s}}$$