ENEE610_091003

Note Title 9/10/2003

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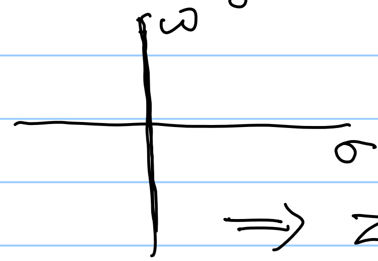
Lossless $Z(s)$: $\underset{n\times n}{Z}(j\omega) + Z^{T*}(j\omega) = 0_{n\times n}$

$s = \sigma + j\omega$



if rational (finite # of poles)
if real coefficients $* \to$ onto this j

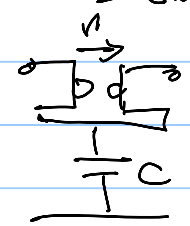
$$\Rightarrow Z(j\omega) + Z^{T}(-j\omega) = 0_{n\times n}$$

$$\Rightarrow Z(s) + Z^{T}(-s) = 0_{n\times n}$$ because

true for all s (except possibly poles) as true on a dense set of $s = j\omega$ (when rational).

$\therefore \; Z(s) = -Z^T(-s)$ if lossless (real-rational)

Ex:



$$Z = \begin{bmatrix} 1/Cs & r + 1/Cs \\ -r + \frac{1}{Cs} & 1/Cs \end{bmatrix} = Z(s)$$

$$-Z(-s) = \begin{bmatrix} \frac{-1}{-Cs} & -r + \frac{-1}{-Cs} \\ +r + \frac{-1}{-Cs} & \frac{-1}{-Cs} \end{bmatrix} \Longrightarrow$$ this is a lossless 2-port

notation $Z(-s) = Z(s)_*$ (call $*$ the Hurwitz conjugate)