KFUPM-Electrical Engineering Department

EE205: Electric Circuits II

Dr. Ali Muqaibel

Summary of Complex Frequency Domain (s –Domain)

- Complex frequency domain is needed when analyzing circuits containing sources of damped sinusoidal form; $A e^{\sigma t}\cos(\omega t+\theta)$. If the exponential is not there ($\sigma = 0$) then normal $j\omega$-frequency domain is enough to get the steady state response.
- The complex frequency (s-domain) is a generalization for the $j\omega$- frequency domain.
- The impedances of the circuit components in s-domain are:

$Z_R = R$	$Z_L = sL$	$Z_C = 1/(sC)$

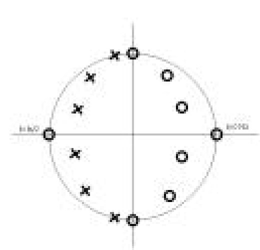
where: $s = \sigma + j\omega$ (σ is found from the exponential term ; ω is the angular frequency) .
L = inductance , C = capacitance, R = resistance.

- After converting the circuit you can use any tech. studied in "Circuit I" such as source transformation, Thevinan and Norton equivalent circuits.
- The transfer function $H(s)$ = (output as a function of s) / (input as a function of s) .
- The output or the input in the transfer function can be voltage or current.
- Definitions :

<u>*Zeros* :</u> the values that make the nominator of the transfer function equals to zero .

<u>*Poles* :</u> the values that make the denominator of the transfer function equals to zero .

- The location of the poles is very important because it determines the type of response of the circuit. To understand this point, use Matlab rlcdemo (type *rlcdemo* and hit enter) the change the type of circuit and the values of R, L, and C. Observe the effect on the circuit response and the location of the poles/zeros.
- For stable operation no poles should appear on the right-half of the s-plane. *Why?*
- For plotting the zeros we use o , while for plotting the poles we use X .



This is not a comprehensive summary. It is meant to help you visualize the main ideas.

Regards, Dr. Muqaibel