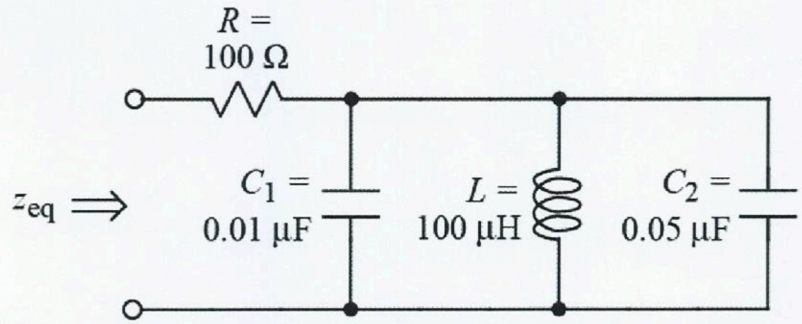
ECE 1250
S 13

EXAM #3 prob 5 solution

Ex:



Find the numerical value of the equivalent impedance, z_{eq}, for the above circuit. Frequency ω = 500 kr/s. Express your answer in polar form.

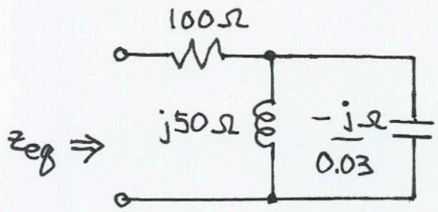
sol'n: We convert to impedances in the frequency domain. We may sum the paralle C's first.

$$C = C_1 + C_2 = 0.01\,\mu F + 0.05\,\mu F = 0.06\,\mu F$$

$$\frac{1}{j\omega C} = \frac{1\ \Omega}{j\,500k(0.06\mu)} = \frac{-j\ \Omega}{0.03} = -j\,33.3\,\Omega$$

$$j\omega L = j\ 500k(100\mu)\,\Omega = j50\,\Omega$$

Our frequency domain model is as follows:



We now compute the impedance of the parallel L and C:

$$z_{LC} = \frac{1}{\frac{1}{j50\Omega} + j\,0.03} = \frac{1}{-j0.02 + j0.03} = -j\,100\,\Omega$$

We add the series R to get z_{eq}.

$$z_{eq} = 100\,\Omega - j\,100\,\Omega$$

Now we convert to polar form.

$$z_{eq} = 100\sqrt{1^2 + (-1)^2}\; e^{j\tan^{-1}\left(\frac{-100}{100}\right)}\;\Omega$$

or

$$z_{eq} = 100\sqrt{2}\; e^{-j45°}\;\Omega$$

or

$$z_{eq} \doteq 141\; e^{-j45°}\;\Omega$$