ECE 311 - Homework #15
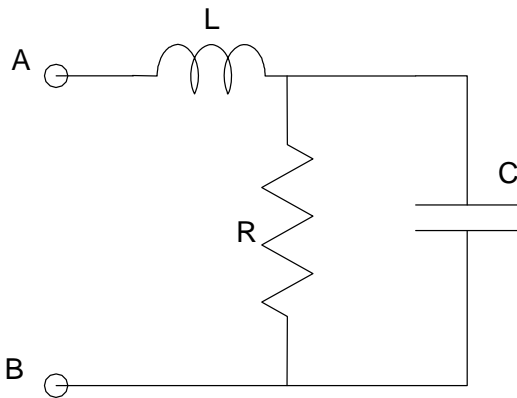
L and C in the LaPlace Domain

Find the LaPlace impedance from A to B for the following circuits. Assume zero initial conditions:
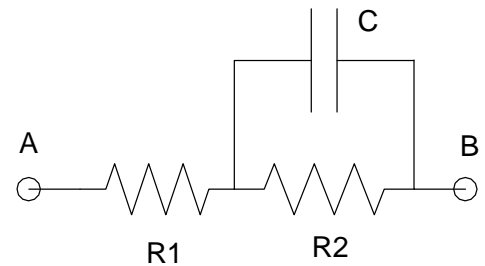
$$R \to R$$

$$L \to Ls$$

$$C \to \frac{1}{Cs}$$

Problem 1

Problem 2

Problem 1) Add the resistor and capacitor in parallel

$$Z_1 = Ls + \left(\frac{1}{R} + \frac{1}{1/Cs} \right)^{-1}$$

$$Z_1 = Ls + \left(\frac{1}{\frac{1}{R}+Cs} \right)$$

$$Z_1 = Ls + \left(\frac{R}{1+RCs} \right)$$

$$Z_1 = \left(\frac{Ls(1+RCs)}{1+RCs} \right) + \left(\frac{R}{1+RCs} \right)$$

$$Z_1 = \left(\frac{R+Ls(1+RCs)}{1+RCs} \right)$$

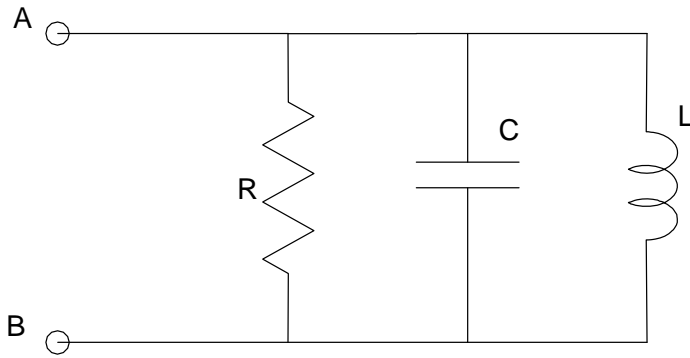$$\boxed{Z_1 = \left(\frac{RLCs^2+Ls+R}{1+RCs} \right)}$$

Problem 2) Same but use R1 instead of Ls

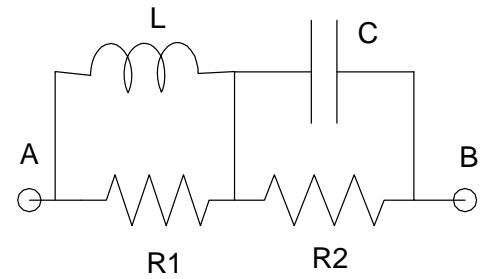$$Z_2 = R_1 + \left(\frac{1}{\frac{1}{R_2}+Cs} \right)$$

$$Z_2 = R_1 + \left(\frac{R_2}{1+R_2Cs} \right)$$

$$Z_2 = \left(\frac{R_1(1+R_2Cs)+R_2}{1+R_2Cs} \right)$$

$$\boxed{Z_2 = \left(\frac{R_1R_2Cs+R_1+R_2}{1+R_2Cs} \right)}$$

Problem 3

Problem 4

Problem 3:

$$Z_3 = \left(\frac{1}{R} + \frac{1}{1/Cs} + \frac{1}{Ls}\right)^{-1}$$

$$Z_3 = \left(\frac{1}{\frac{1}{R}+Cs+\frac{1}{Ls}}\right)$$

$$Z_3 = \left(\frac{1}{\frac{1}{R}+Cs+\frac{1}{Ls}}\right)\left(\frac{RLs}{RLs}\right)$$

$$\boxed{Z_3 = \left(\frac{RLs}{RLCs^2+Ls+R}\right)}$$

Problem 4:

$$Z_4 = \left(\frac{1}{\frac{1}{Ls}+\frac{1}{R_1}}\right) + \left(\frac{1}{\frac{1}{1/Cs}+\frac{1}{R_2}}\right)$$

$$Z_4 = \left(\frac{1}{\frac{1}{Ls}+\frac{1}{R_1}}\right) + \left(\frac{1}{Cs+\frac{1}{R_2}}\right)$$

$$Z_4 = \left(\frac{1}{\frac{1}{Ls}+\frac{1}{R_1}}\right)\left(\frac{R_1Ls}{R_1Ls}\right) + \left(\frac{1}{Cs+\frac{1}{R_2}}\right)\left(\frac{R_2}{R_2}\right)$$

$$Z_4 = \left(\frac{R_1Ls}{R_1+Ls}\right) + \left(\frac{R_2}{R_2Cs+1}\right)$$

$$Z_4 = \left(\frac{R_1Ls}{R_1+Ls}\right)\left(\frac{R_2Cs+1}{R_2Cs+1}\right) + \left(\frac{R_2}{R_2Cs+1}\right)\left(\frac{R_1+Ls}{R_1+Ls}\right)$$

$$Z_4 = \left(\frac{R_1Ls(R_2Cs+1)+R_2(R_1+Ls)}{(R_1+Ls)(R_2Cs+1)}\right)$$

$$\boxed{Z_4 = \left(\frac{R_1R_2LCs^2+(R_1+R_2)Ls+R_1R_2}{(R_1+Ls)(R_2Cs+1)}\right)}$$