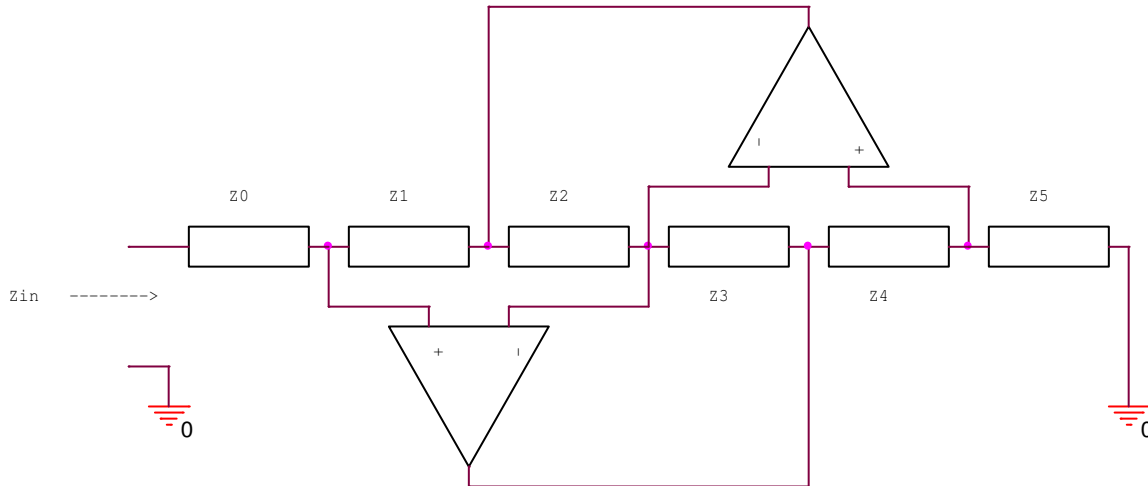


ENEE 417 Experiments Week 5a Spring 2016

Week starting W 03/07/16; active circuits (C=>L, R=>-R)

1. The following circuit is called a GIC (=General Impedance Converter). When the op-amps are ideal, it is known that (where all Z's are impedances)

$$Z_{in}(s) = Z_0(s) - (Z_1(s) \cdot Z_3(s) \cdot Z_5(s)) / (Z_2(s) \cdot Z_4(s))$$



a) Verify the above formula for $Z_{in}(s)$. A special case is analyzed on p. 1286 of Sedra/Smith, 6th edition. Note that the return of signal current of the op-amps is not shown, allowing input current to differ from the current in Z_5 .

b) Choose $Z_0=0$, $Z_1(s)=Z_2(s)=Z_3(s)=Z_5(s)=R$, $Z_4(s)=1/(Cs)$. In this case loading by a capacitor makes $Z_{in}(s)$ look like an inductor. Construct the circuit using the 1458 op-amps and various values of R and C (start with $R=2\text{K}\Omega$ and $C=1\text{microFarad}$).

c) Devise means to test if an inductor is really seen, one means being via a time constant evaluation and another via an LC resonance.

d) Repeat when $Z_0=0$, $Z_1=Z_3=Z_5=R$, $Z_2(s)=Z_4(s)=1/(Cs)$.

2. In the above circuit add Z_6 on the top op-amp as feedback from the output to the + input. Choose $Z_0=0$, $Z_1=Z_2=Z_3=Z_4=R$, $Z_6=R/2$.

It is surmised that $Z_{in}(s) = -Z_5(s)$.

Check this analytically and devise an experiment to check your calculations.

3. Catch up on all previous projects so that you can start your base paper experiments next time.