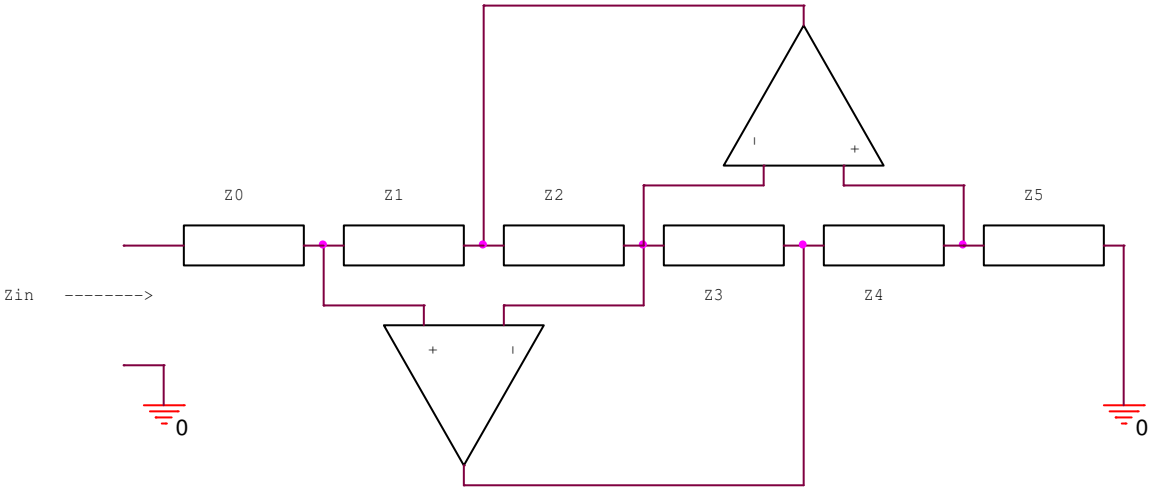
File: c:\temp\courses\spring2019\417\week_5S19GIC.doc RWN 03/1/19

ENEE 417 Experiments Week 5 Spring 2019
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). It is covered on pages 1322 -1330 in the 7th edition os Sedra/Smith to give various 2nd order circuits.

$$Zin(s) = Z0(s) - (Z1(s)\cdot Z3(s)\cdot Z5(s))/(Z2(s)\cdot Z4(s))$$



a) Verify the above formula for Zin(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 Z5.

b) Choose Z0=0, Z1(s)=Z2(s)=Z3(s)=Z5(s)=R, Z4(s)=1/(Cs). In this case loading by a capacitor makes Zin(s) look like an inductor. Construct the circuit using the 1458 op-amps and various values of R and C (start with R=2KOhm and C=1microFarad).

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 Z0=0, Z1=Z3=Z5=R, Z2(s)=Z4(s)=1/(Cs).

2. In the above circuit add Z6 on the top op-amp as feedback from the output to the + input. Choose Z0=0, Z1=Z2=Z3=Z4=R, Z6=R/2.

It is surmised that Zin(s) = -Z5(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.