ELEN 622 (ESS) **Due: September 21, 2017**
Fall 2017

HOMEWORK #1

Problem 1. Design a LP with the following specs:

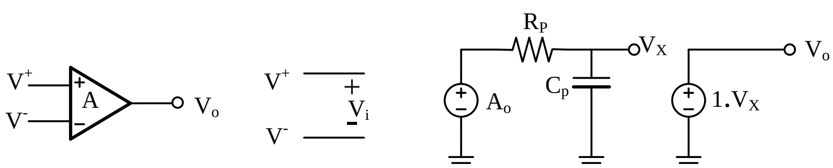
$$H_{LP}(o) = 1,\ \omega_o = 2\pi \times 10^6, Q = 4$$

Using the Sallen and Key (p. 13 Lect. 2) unity gain implementation.

a) Assume an ideal Op Amp and determine the component values and plot the magnitude and phase vs ω.
b) Assume now a real Op Amp characterized by

$$A(s) = \frac{A_o}{1 + s/\omega_p} = \frac{GB}{s + \omega_p}$$

Which has a macromodel shown below



Let $\omega_p = 2\pi \times 10^3\ rad/s$. Determine the value of GB yielding a magnitude or phase error less than 5% of the filter.

Problem 2. Design the same LP specs for the TT biquad (p. 21, Lect. 3).

a) Assume ideal Op Amps and determine the component values of the TT biquad,
b) Using Simulink simulate your designed filter for i) ideal Op Amp and for ii) a non-ideal Op Amp with $A(s) \cong \frac{GB}{s}$ when $GB = 20\omega_o$
c) Provide in a table form the results of b) and include the error in magnitude, phase and group delay at ω_o.
d) Modify and/or add compensation components for GB. Simulate your new design and compare with previous.

Problem 3. Design an RC Miller integrator for $\omega_o = 2\pi \times 10^6\ rad/s$

a) Assume an ideal OP Amp

b) Let $GB = 2\pi \times 5 \times 10^6$ for $A(s) = \frac{GB}{s}$

c) Add a resistor R_c in series with the feedback capacitor such that an ideal integrator is obtained.

Summarize your results in a table for $|H(j\omega_o)|$, phase $(\mathrm{H} + (\mathrm{j}\omega_\mathrm{o}))$ for the three cases .

You can simulate results in CADENCE and/or SIMULINK.

EXTRA CREDIT

Repeat problem 1 for the LP Rauch Filter (p.13, Lect. 2).