EE 508
Lab 4 Sensitivity Analysis of Filter Structures
Fall 2024
Due Tuesday October 22

Two second-order bandpass filters are shown below. Characteristics of the first filter were discussed in the lecture. There have been claims that the second has better performance. Assume both are designed with $C_1=C_2=C$.

Part 1 Obtain parametric expressions for the transfer functions of both filters including the effects of the operational amplifier time constant (i.e. assume Op Amp gain is $A(s)=\frac{GB}{s}=\frac{1}{\tau s}$

Part 2 Obtain parametric expressions for ω_0 and Q for both filters if the op amps are ideal.

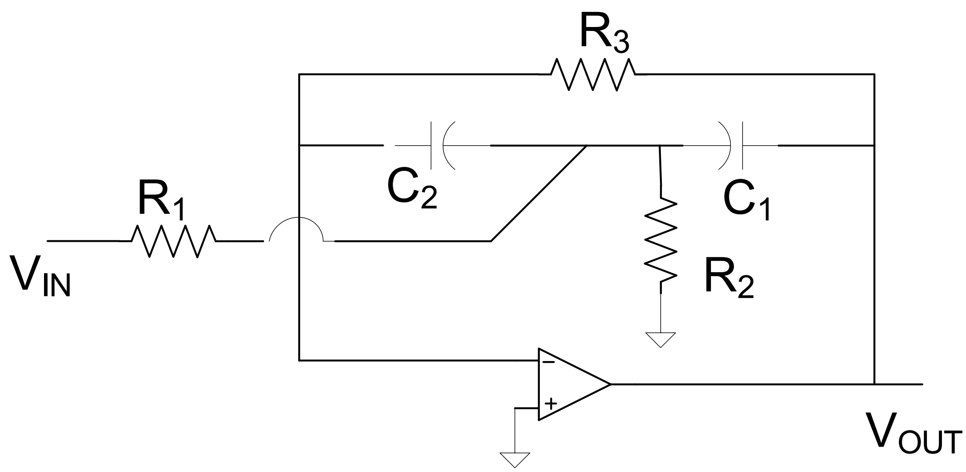
Part 3 Analytically obtain approximate expressions for $\frac{\Delta Q}{Q}$ and $\frac{\Delta f_0}{f_0}$ due to changes in R_1 and due to changes in $\tau=GB^{-1}$ for both circuits ($\omega_0=2\pi f_0$)

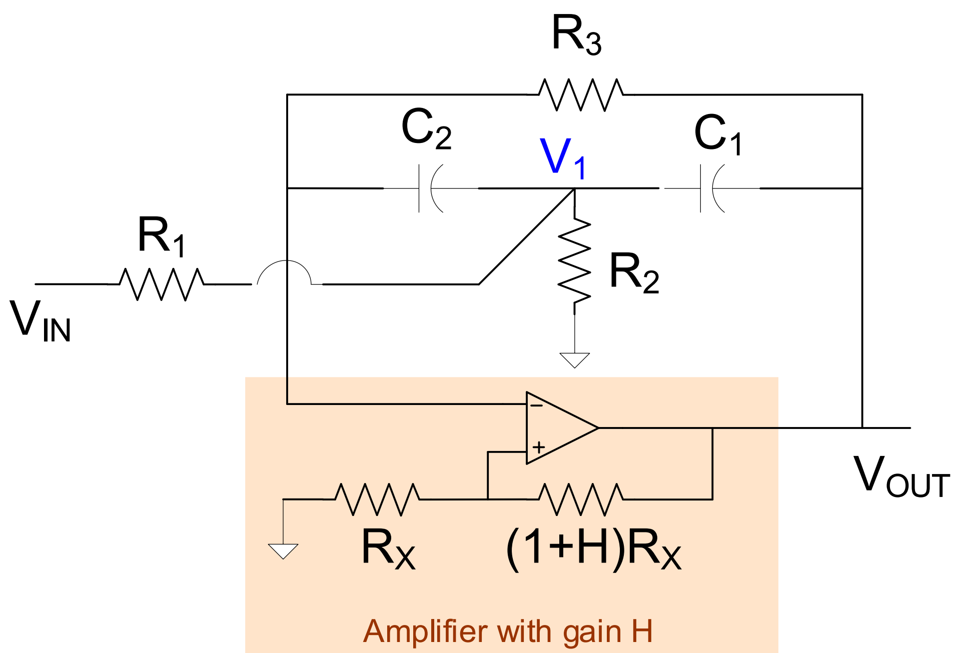
Part 4 Design both filters for a nominal Q=10 and f_0=10KHz if the operational amplifiers are ideal. In the design of the second circuit, select a value of H that will make $\frac{\Delta Q}{Q}$ due to changes in τ small.

Part 5 If the GB or the Op Amp is 1MHz, how do $\frac{\Delta Q}{Q}$ and $\frac{\Delta f_0}{f_0}$ obtained from the analytical expressions obtained in Part 2 compare to the actual $\frac{\Delta Q}{Q}$ and $\frac{\Delta f_0}{f_0}$?

Part 6 Show that the first filter is bilinear in R_1. Also show it is bilinear in C_1.

Part 7 Comment on the relative performance of these two filter architectures.


R3
C2
C1
R1
VIN
R2
VOUT


R3
C2
V1
C1
R1
R2
VIN
VOUT
RX
(1+H)RX
Amplifier with gain H