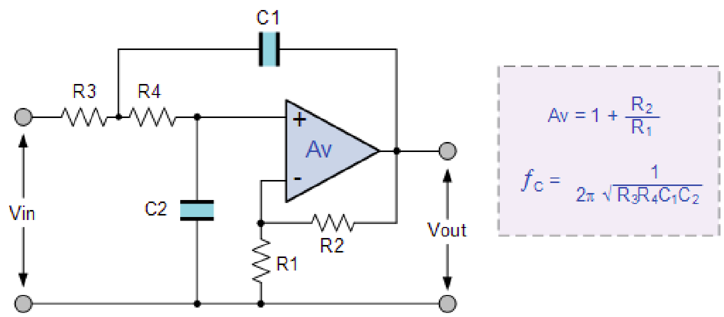
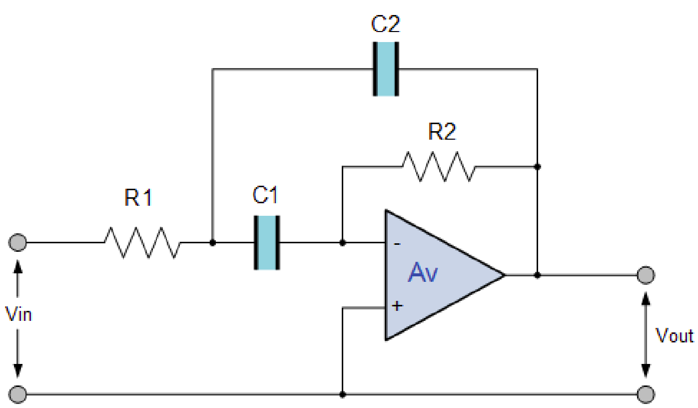
Filters/Wave Form Tutorial Sheet

Q1. The above figure shows a two-pole low pass filter. Obtain an expression for



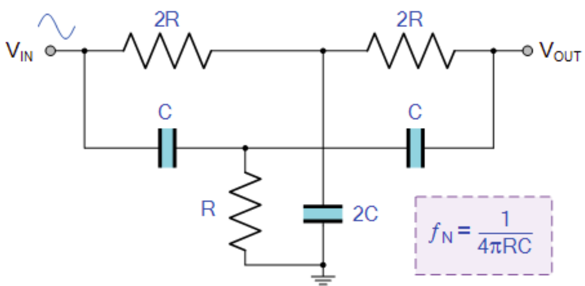
the complex function voltage gain $A_v = v_{out}/v_{in}$ and show that it falls off at 40 dB/decade for $f > f_c$.

Q2. For the band pass filter in the above figure, calculate the complex function



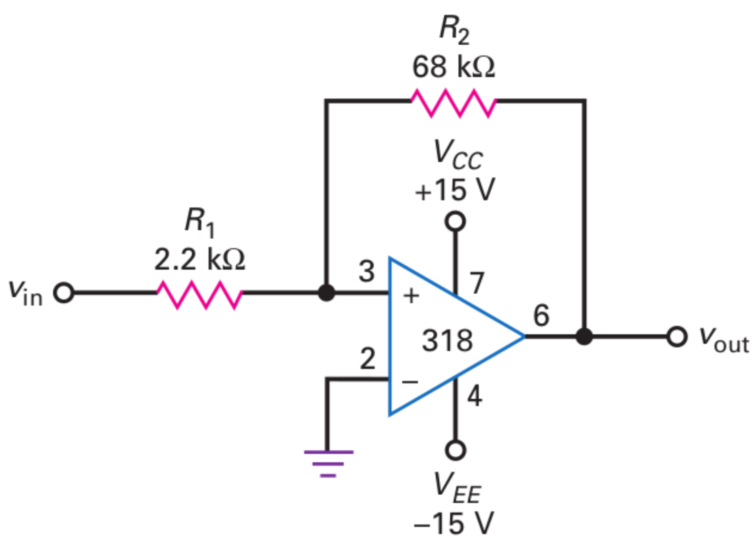
voltage gain $A_v = v_{out}/v_{in}$ and show that it behaves like the voltage gain of a band pass filter. What are the expressions for the lower and higher cut-off frequencies?

Q3. Band stop filters (and band pass filters too) can be of two varieties: Narrow band and Wide band. If f_L and f_H are the lower and higher cut-off frequencies, then, we define $Q = \sqrt{f_H f_L}/(f_H - f_L)$. The denominator of Q, of course, is the **band width** while the numerator, which is the geometric mean of f_L and f_H, is called **mid-band frequency** f_0. The filter is called a wide-band filter if $Q \leq 1$ and a narrow-band filter if $Q \geq 2$. The narrower the band-width, the larger is the value of Q.



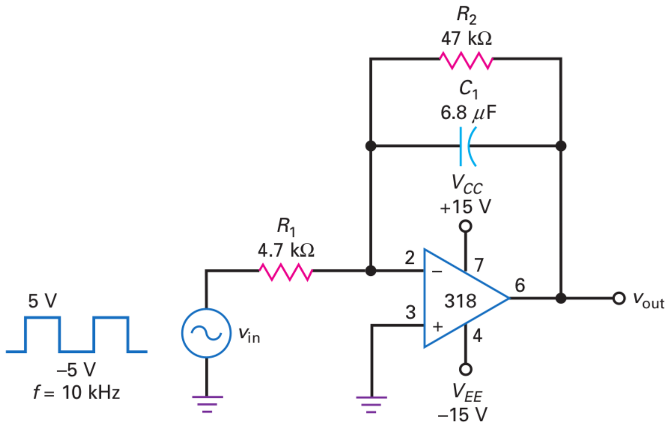
The figure above shows the **notch band stop filter**, which is designed to cut-off a particular frequency. Calculate the complex function voltage gain $A_v = v_{out}/v_{in}$ and plot $A_v(f)$ as a function of f.

Q4. Assume that v_{in} is a sinusoid of amplitude 10 V. Sketch variation in v_{out} as v_{in}



increases from -10 V to +10 V. Also sketch the variation in v_{out}, when v_{in} decreases from +10 V to -10 V.

Q5. Sketch v_{out} as a function of v_{in}.



Q6. What is the frequency of v_{out} of the wave form generator in the given circuit?