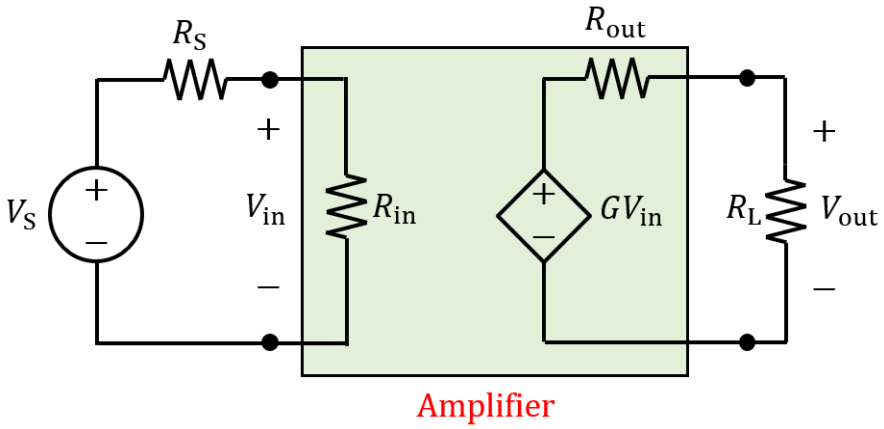
CG1111 Engineering Principles and Practice I

Tutorial for Week 9

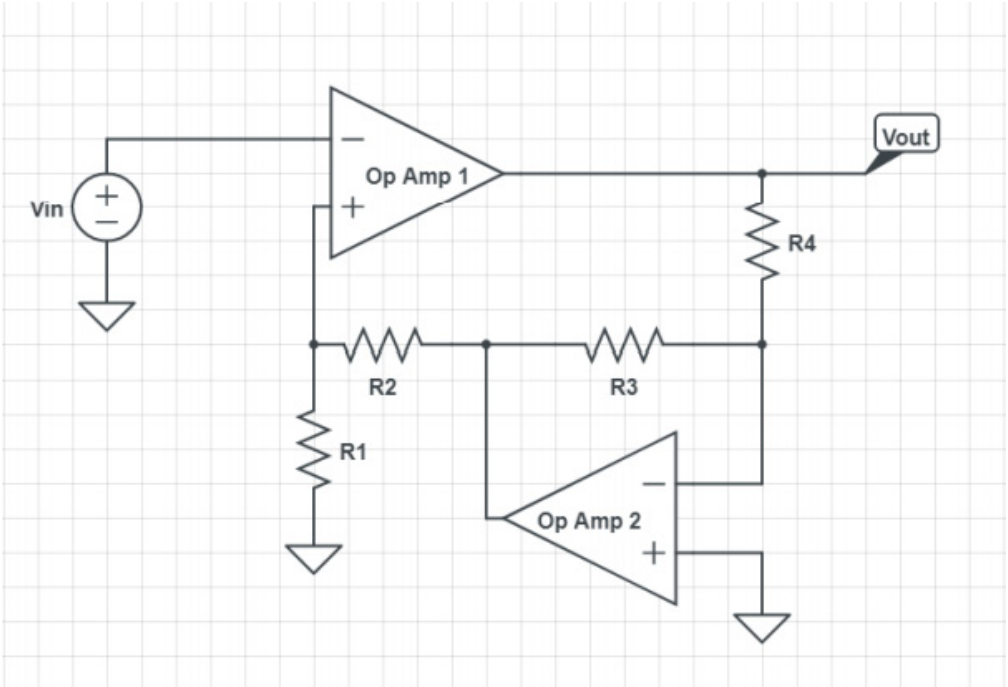
Operational Amplifiers and Filters

1. Show that if $R_{\text{in}} = R_{\text{L}}$, then the power gain in dB for an amplifier circuit is given by

$$\text{Power gain (dB)} = 20\ \log_{10}\left|\frac{V_{\text{out}}}{V_{\text{in}}}\right| \text{ dB}$$

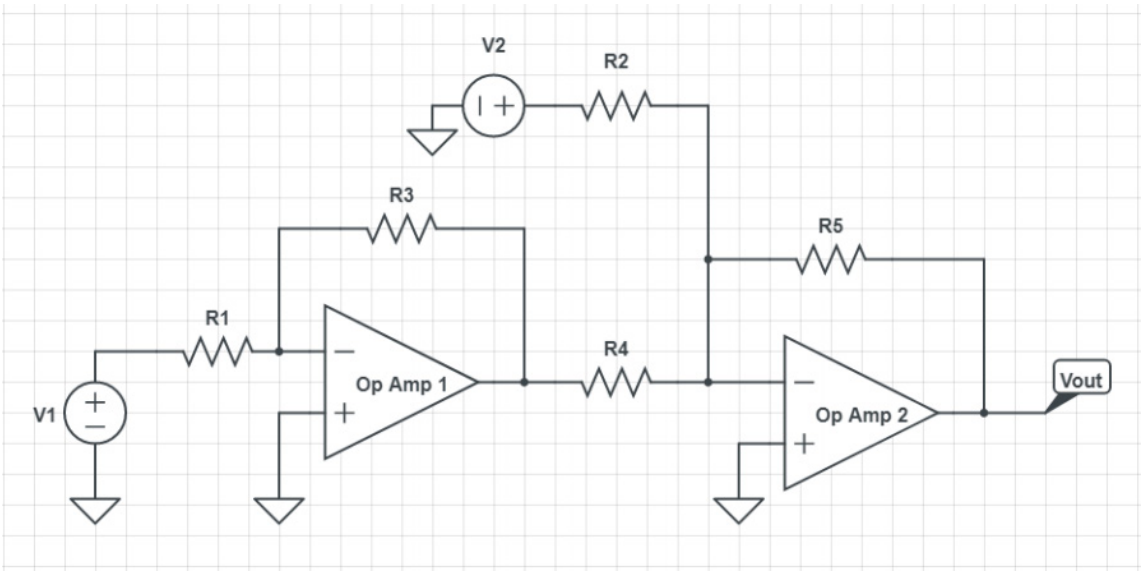


2. Calculate the voltage gain (V_{out}/V_{in}) of Op Amp 1 in the figure below:



Ans: $\frac{V_{\text{out}}}{V_{\text{in}}} = -(1 + \frac{R_2}{R_1}) \times \frac{R_4}{R_3}$

3. Derive the expression relating V_{out} and the two input voltages, V_1 and V_2.



After obtaining the expression relating the output to the inputs for the configuration, can you design the resistance values such that Vout is the difference between the two input signals amplified by a gain factor?

Ans: $V_{\text{out}} = \left(\frac{R_5}{R_4} \times \frac{R_3}{R_1} \times V_1\right) - \left(\frac{R_5}{R_2} \times V_2\right)$

4. An audio song has frequencies in the range of 100-3000 Hz. It is corrupted with a high frequency noise of 10 kHz. You need to design a low-pass filter to suppress the 10 kHz noise by 20 dB relative to the passband gain. What should be the cut-off frequency of the low-pass filter?

Ans: $f_c = 1$ kHz