# Homework #7   Op-amps & filters

1) Design an amplifier with an input impedance of at least **100KΩ** and a gain of **1000**. The input is slow moving so to eliminate excess noise the gain should roll off at higher frequencies (say above **100Hz**). Use a single LM741 op-amp with +/-15V supplies.

The input impedance of a non-inverting amplifier is that of the op-amp itself (typically about 2MΩ for the LM741). The gain in the pass band is set by 1+R2/R1 = 1+1MΩ/1KΩ = 1001 (close enough)**.** The resistors values are kept reasonable (i.e. not extremely low, less than 100Ω, or extremely high, greater than 10MΩ). The cutoff frequency is set to 100Hz by R2 & C2. $1/(2\pi R2C2) = 100Hz$.
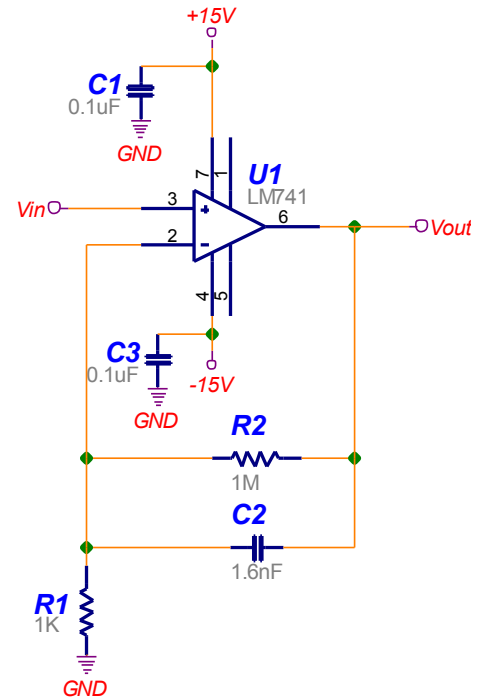
2) Design an amplifier with a gain of **10,000 at 1KHz**. The gain should roll off above and below this frequency (say below **100Hz** and above **10KHz**). The input impedance can be as low as **1KΩ**. Because the LM741 bandwitdh is about 1MHz use two LM741 op-amps with +/- 15V supplies.
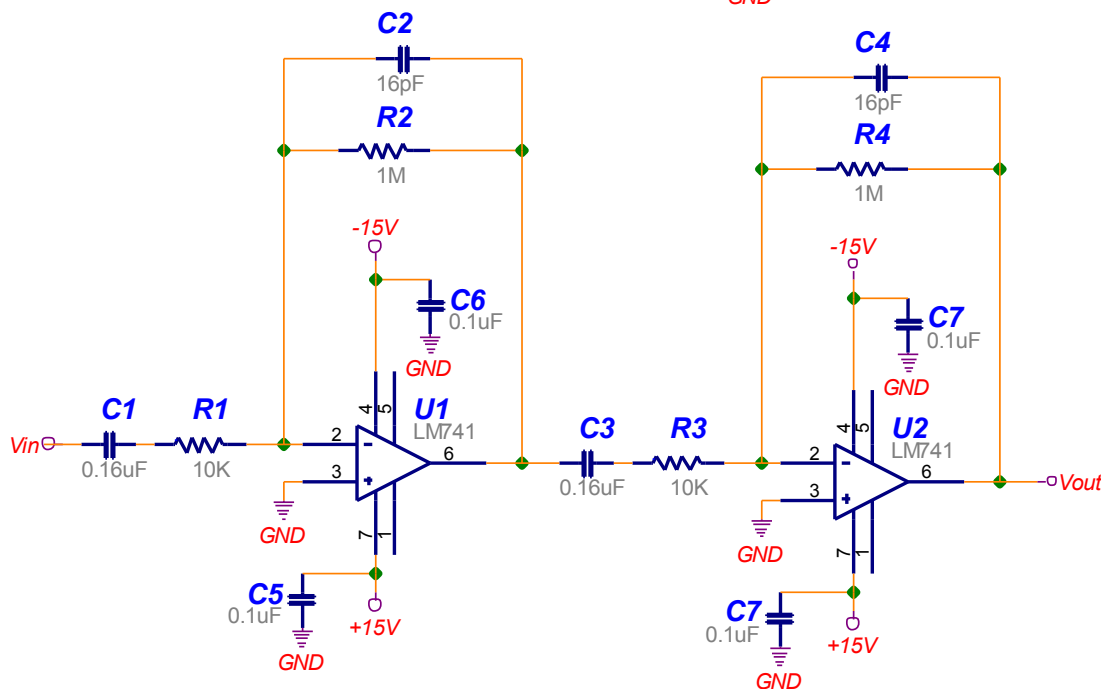
The input impedance of an inverting amplifier is the input resistor (the non-inverting input is grounded therefore the inverting input is held at virtual ground). With R1 = 10KΩ the input impedance of the amp is 10 KΩ. The gain is split evenly between the two stages to maximize the bandwidth (100*100=10,000). R1C1 & R3C3 set the lower cutoff frequency to 100Hz. (Note: The lower 3db point of each of the two stages is 100Hz. The 3db point of the combined stages will be slightly higher, about 155Hz). R2C2 and R4C4 set the upper cutoff frequency of each stage to 10KHz. Again, the cutoff frequency of the combined stages would be slightly lower, about 6.45KHz. One could adjust the size of the filter caps to get 100Hz & 10KHz as the 3db point of the combined stages if needed.