Lab 4: Passive Filters

1. **Source Impedance Review** (30 minutes)

   Set the output of the function generator to a 1 Hz (or less) square wave with a voltage which varies between 0 V and 5 V. Try to use the output of the function generator to power a light bulb (if you do not see any light, then increase the voltage until you do).

   Measure the output voltage versus time when loaded by the light bulb. Is the output voltage consistent with what you would expect for a source with a 50 Ω impedance driving a light bulb?

   … By the way, what is the input impedance of the oscilloscope?

2. **High-Pass Filter** (1 hour)

   Design and construct a *high-pass RC filter* that can filter out 60 Hz but still pass signals in the kHz region.

   Connect a 10 kHz output from your signal generator to one terminal of the 6.3V transformer on your breadboard. This will add a large 60 Hz component onto the signal. Your filter should be able to clean it up.

   Measure the ratio of signal to noise (S/N), and compare it to your calculations, where "signal "is the peak-to-peak amplitude of the 10 kHz sine wave, and "noise" is the peak-to-peak amplitude of the 60 Hz component.

3. **Band-Pass Filter** (1 hour)

   Design and construct a *band-pass filter* which will only pass frequencies near 10 kHz. (You can do this by combining 2 different *RC* filters.)

   Measure its response (amplitude ratio and phase difference) when driving a load of 100 kΩ at 50 Hz, 100 Hz, 1 kHz, 5 kHz, 10 kHz, 20 kHz, and 50 kHz. Does your circuit behave the way you expect it to?

Bonus (1 hour … maybe more)

Construct the notch filter of design exercise 4-3.

Characterize the performance of the filter (i.e. measure the amplitude ratio and phase difference) when driving a 100 kΩ load.

Does the filter perform the way you designed it to? If not, explain why.