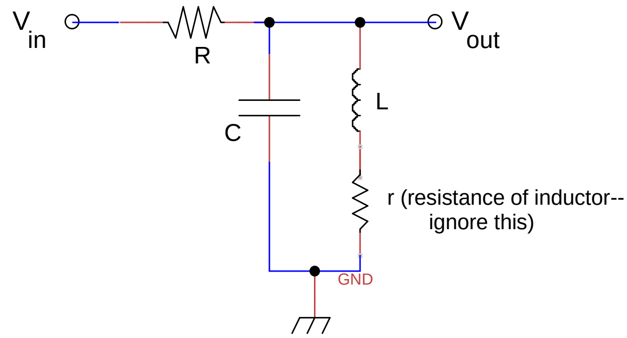
RLC Resonance – Bandpass Filter

You will drive this circuit with a sine wave.



1. Measure the attenuation (dB) and phase shift vs. frequency (Hz) for the RLC this circuit: Use these values:
   R = 100k, C = .01 uF, L = 10mH
   Take sufficient data to generate a pair of Bode plots (magnitude and phase) vs frequency

2. Make the Bode plots and see if you can figure out: what is this filter doing?

3. Determine the Q of the circuit from the magnitude plot,
   $Q \equiv (f_0 / \Delta f_{3dB})$.

4. Change R to 100 ohm, and do another Bode plot, this time for magnitude only. What happened to the Q?

5. Return to R = 100k, change L to 1 mH, C to 0.1 uF. Repeat #4.

Explain these results using the transfer function derived in class:

$$H(\omega) = \frac{V_{out}}{V_{in}} = \left[1 + iR\left(\omega C - \frac{1}{\omega L}\right)\right]^{-1}$$

BONUS:

It is claimed that a square wave can be constructed from this infinite Fourier series:
V_{square} ~ sin(wt)+ 1/3sin(3wt)+ 1/5sinc(5wt)+ 1/7(7sinwt)…

Return the circuit to the original values of R, L C.
Measure these Fourier coefficients as follows:

Drive the circuit with a *square* wave,. Start with the resonant frequency you measured in Part 1 above. Measure the amplitude of the peak of the wave. Then reduce the frequency to 1/3, measure the amplitude of the peak of the wave.

See how many Fourier coefficients you can meaure

HOMEWORK:

Derive this expression for the Q of the circuit and see if your results match this:

$Q = R\sqrt{(C/L)}$