Homework 11 (due May 12):

Problem 1: The transfer function for a circuit is

$$\mathbf{G}(s) = \frac{I_o(s)}{I_g(s)} = \frac{125(s + 400)}{s(s^2 + 2s + 10^4)}$$

1. Use Matlab to plot the gain-magnitude of the transfer function. determine the range of frequencies (i.e. pass band) over which the circuit *amplifies* the input signal by 20 dB. Determine that range of frequencies (i.e. stop band) over which the circuit *attenuates* the input signal by 40 dB.

2. Now try to *sketch* the gain magnitude plot for $\mathbf{G}(s)$ using the methods discussed in class lectures.

Problem 2: A block diagram of a system consisting of a sinuosoidal voltage source, an RLC series bandpass filter and a load is shown in Fig. 1. The internal impedance of the sinusoidal source is $80 + j0$ ohms and the impedance of the load is $480 + j0$ ohms. The RLC series bandpass filter has a 20 nF capacitor, a center frequency of 50 krad/sec, and a quality factor of 6.25.

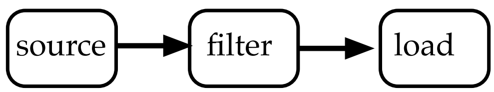

Figure 1: Problem 2

- Draw a circuit diagram of the system.
- Specify the numerical values of L and R for the filter section of the system.
- What is the quality factor of the interconnected system?
- What is the bandwidth (in hertz) of the interconnected system?

Problem 3: Design an op-amp based high-pass filter with cut-off frequency of 4 kHz and a pass-band gain of 8 using a 250 nF capacitor.

1. Draw your circuit, labeling the component values and the output voltage.

2. If the value of the feedback resistor in the filter is changed, but the resistor in the forward path is unchanged, what characteristic of the filter is changed?

3. Redesign the filter by changing its cutoff frequency, so it attenuates a 200 Hz input sinusoid by 20 dB while still keep the desired passband gain of 8.