RC FILTERS AND AC CIRCUIT ANALYSIS

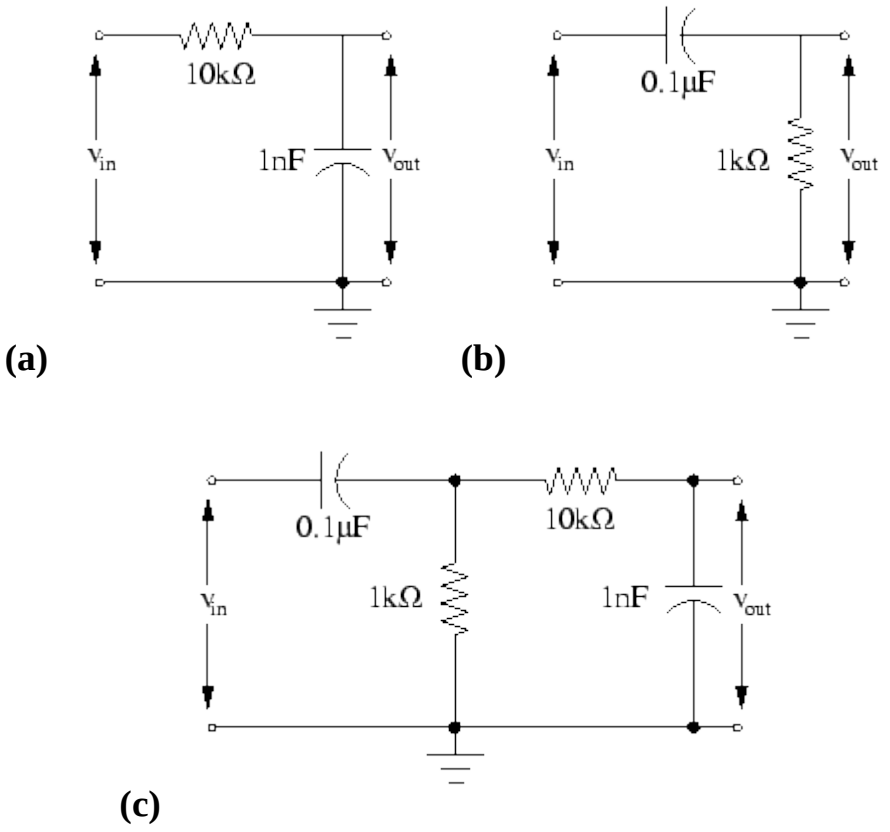

Figure 7: Signal filters.

1. **Exercises**

   The networks of resistors and capacitors shown in Figure 7 are called sometimes called filters. One is a low pass filter, meaning that it transmits low frequency signals to its output terminals favorably. Another is a high pass filter, transmitting high frequency signals favorably. There is also a band pass filter that transmits signals in a frequency band.

Draw the low frequency and high frequency equivalents of these networks, and also for the series RL and RLC circuits you considered in Sections 2.2 and 2.3. On this basis, classify each of these networks as a low pass, high pass, or band pass filter.

Derive general expressions for S and the phase angle for the band pass filter in Figure 7 as a function of the resistances, capacitances, and signal frequency. Use this expression to produce a plot of S vs. frequency. Predict the cutoff frequencies (3 dB points) of the filter.

2. **Simulation**

   Produce S vs. frequency and phase angle vs. frequency plots for the filter circuits of Figure 7 using small signal AC analyses. Does your simulation agree with your calculation of Section 1?

3. **Experiment**

   Set up the band pass filter, driving it with a sinusoidal wave form from the the function generator. Measure S and the phase angle for the circuit over a frequency range 100 Hz - 1 MHz. Also measure the cutoff frequencies of the filter. Produce plots comparing your measured S and phase values with your theoretical calculation / spice analysis.

AC Circuit Analysis Exercises

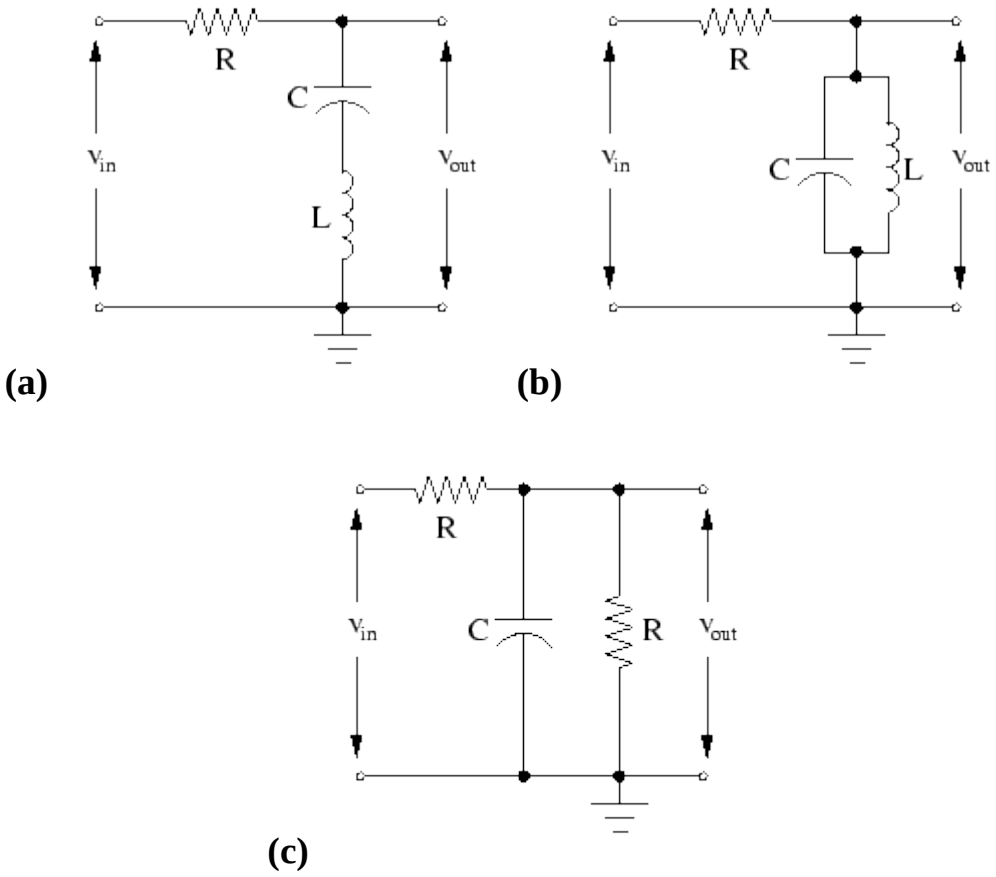

Figure 12: Various filter circuits.

For each circuit shown in Figure 12:

- Apply whichever method you wish (Node Voltage, Mesh Current, ``voltage divider thinking'') to derive expressions for $S = \left|\frac{V_{out}}{V_{in}}\right|$ and the phase angle.
- Check your calculations against a Spice simulation.

- Find the Thevenin equivalent voltage and impedance for the output terminals indicated.
- Comment on the function of the circuit as a filter converting V_{in} into V_{out}.

Source: http://webpages.ursinus.edu/lriley/ref/circuits/node3.html