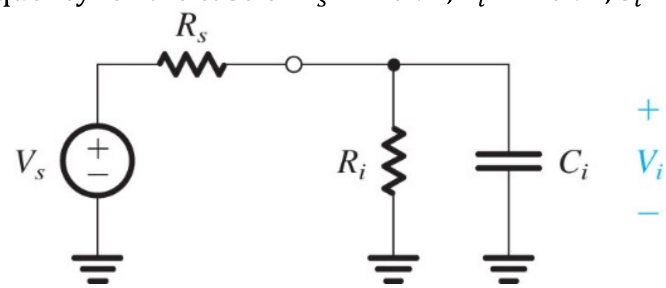
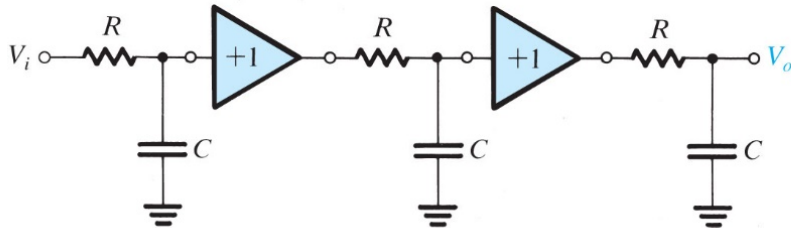
HW#1
(Submit to bCourses by 11 pm on 2/1)

1) The circuit below shows a signal source connected to the input of an amplifier. R_s is the source resistance, and R_i and C_i are the input resistance and capacitance, respectively, of the amplifier. Derive an expression for $\frac{V_i(s)}{V_s(s)}$, where $s = j\omega$. What type of filter is this? Find the 3-dB frequency for the case of $R_s = 10k\Omega, R_i = 40k\Omega, C_i = 5\ pF$.



2) The unity-gain voltage amplifiers shown below have infinite input resistance and zero output resistance and thus functions as perfect buffers. Furthermore, assume that their gain is frequency independent. Convince yourself that the overall gain V_0/V_i will drop by 3 dB below the value at dc at the frequency for which the gain of each RC circuit is 1 dB down. What is that frequency in terms of R and C?



3) A voltage amplifier has the transfer function

$$A_v = \frac{1000}{\left(1 + \frac{jf}{10^5}\right)\left(1 + \frac{10^2}{jf}\right)}$$

Using the Bode plots for low-pass and high-pass networks, sketch a Bode plot for $|A_v|$. Give approximate values for the gain magnitude at f=10 Hz, 10^2 Hz, 10^3 Hz, 10^4 Hz, 10^5 Hz, 10^6 Hz, 10^7 Hz, and 10^8 Hz. Find the bandwidth of the amplifier (defined as the frequency range over which the gain remains within 3 dB of the maximum value).