Example: Design a band-pass filter to pass signals between 160 Hz and 8 kHz. The load for this circuit is 1 MΩ.

As this is wide-band, band-pass filter \((\omega_u/\omega_l = f_u/f_l = 50 \gg 1)\), we use two low- and high-pass RC filter stages similar to circuit above.

The high-pass filter sets the lower cut-off frequency, and the 1 MΩ load sets the output impedance of this stage. Thus:

\[
Z_o|_{\text{max}} = R_2 \ll 1 \text{ MΩ} \quad \rightarrow R_2 \leq 100 \text{ kΩ}
\]

\[
\omega_c(\text{High-pass}) = \omega_l = \frac{1}{R_2C_2} = 2\pi \times 160 \quad \rightarrow R_2C_2 = 1 \times 10^{-3}\text{kΩ}
\]

One should choose \(R_2\) as close as possible to 100 kΩ (to make the \(C_2\) small) and \(R_2C_2 = 1\times10^{-3}\) using commercial values of resistors and capacitors. A good set here are \(R_2 = 100\text{ kΩ}\) and \(C_2 = 10\text{ nF}\).

The low-pass filter sets the upper cut-off frequency. The load for this component is the input resistance of the high-pass filter, \(Z_i|_{\text{min}} = R_2 = 100\text{ kΩ}\). Thus:

\[
Z_o|_{\text{max}} = R_1 \ll 100\text{kΩ} \quad \rightarrow R_1 \leq 10 \text{ kΩ}
\]

\[
\omega_c(\text{Low-pass}) = \omega_u = \frac{1}{R_1C_1} = 2\pi \times 8 \times 10^3 \quad \rightarrow R_1C_1 = 2 \times 10^{-5}
\]

As before, one should choose \(R_1\) as close as possible to 10 kΩ and \(R_1C_1 = 2 \times 10^{-5}\) using commercial values of resistors and capacitors. A good set here are \(R_1 = 10\text{ kΩ}\) and \(C_1 = 2\text{ nF}\).

In principle, we can switch the position of low-pass and high-pass filter stages in a wide-band, band-pass filter. However, the low-pass filter is usually placed before the high-pass filter because the value of capacitors in such an arrangement will be smaller. (Try redesigning the above circuit with low-pass and high-pass filter stages switched to see that one capacitor become much smaller and one much larger.)