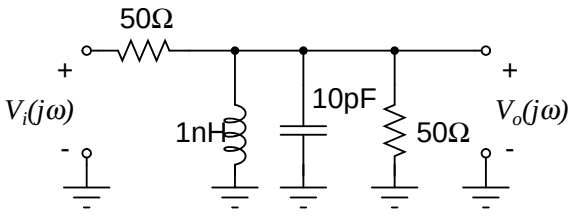
Indian Institute of Technology, Delhi
EEL 101: Fundamentals of Electrical Engineering
Tutorial 7, 13th March, 2008

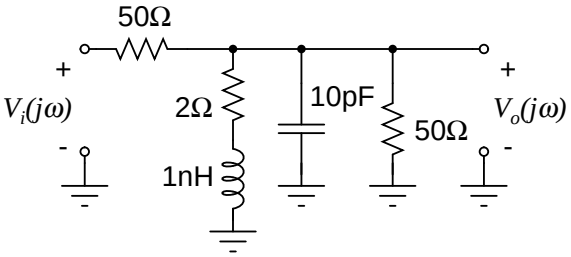
1. Fig. (a) is the circuit diagram of a filter. Evaluate gain, $|\frac{V_o(j\omega)}{V_i(j\omega)}|$. What class of filter is this? What is the center frequency (in Hz)? Find the range of frequencies for which the magnitude of the gain is less than $1/\sqrt{2}$ of the maximum gain.

2. Now consider the filter in Fig. (b). The small 2Ω resistor in series with the inductor signifies the losses in the inductor because of the wire resistance. Find the range of frequencies for which the magnitude of the gain is less than $1/\sqrt{2}$ of the maximum gain.

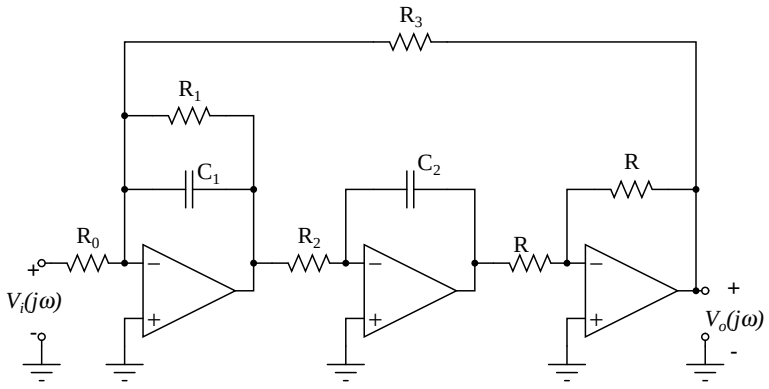
3. Consider the active filter in Fig. (c). Evaluate, by inspection, the gain of this filter at DC ($\omega = 0$). Evaluate the gain, $|\frac{V_o(j\omega)}{V_i(j\omega)}|$. This filter is called a "general biquad", and through proper choice of components, $V_o(j\omega)/V_i(j\omega)$ can be designed to be any 2nd order polynomial by any 2nd order polynomial of choice. Prove to yourself that this is true. What do you think is the limitation for such a filter?


50Ω
+
$V_i(j\omega)$
-
1nH
10pF
50Ω
+
$V_o(j\omega)$
-

(a)


50Ω
+
$V_i(j\omega)$
-
2Ω
1nH
10pF
50Ω
+
$V_o(j\omega)$
-

(b)


R_3
R_1
C_1
C_2
R
R_0
R_2
R
+
$V_i(j\omega)$
-
+
$V_o(j\omega)$
-

(c)