VE 216 Lab 2 PreLab 周雅婷 518021911039

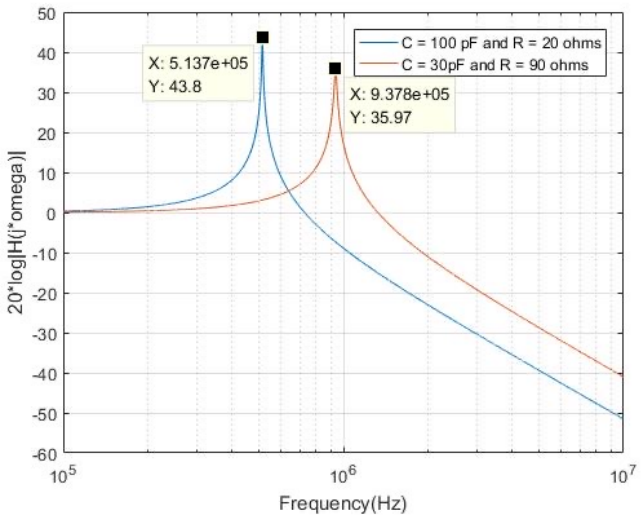
1. (a). $H(j\omega) = \frac{V_{out}(j\omega)}{V_{ant}(j\omega)} = \frac{\frac{1}{j\omega C}}{R_{ant} + \frac{1}{j\omega C} + j\omega L} = \frac{\frac{1}{sC}}{R + \frac{1}{sC} + sL} = \frac{1}{LCs^2 + RCs + 1}$

(b). Values from plot:

	Peak freq. (kHz)	3dB BW (kHz)	Quality Factor
C = 100 pF	513.7	3.3	155.7
C = 30pF	937.8	14.9	62.9

Values from equations:

	Peak freq. (kHz)	3dB BW (kHz)	Quality Factor
C = 100 pF	513.67	3.32	154.92
C = 30pF	937.83	14.92	62.85



2. (a). $\begin{cases} \frac{V_A - V_i}{R_1} + \frac{V_A}{R_2} + \frac{V_A - V_o}{\frac{1}{j\omega C}} + \frac{V_A - 0}{\frac{1}{j\omega C}} = 0 \\ \frac{0 - V_A}{\frac{1}{j\omega C}} + \frac{0 - V_o}{R_3} = 0 \end{cases}$

$$H(j\omega) = \frac{V_o}{V_i} = \frac{-\frac{R_2R_3C}{R_1+R_2}j\omega}{\frac{R_1R_2R_3}{R_1+R_2}C^2(j\omega)^2 + \frac{2R_1R_2}{R_1+R_2}Cj\omega + 1} = \frac{-\frac{R_2R_3C}{R_1+R_2}s}{\frac{R_1R_2R_3C^2}{R_1+R_2}s^2 + \frac{2R_1R_2C}{R_1+R_2}s + 1}$$

Therefore $\begin{cases} a_2 = \frac{R_1R_2R_3C^2}{R_1+R_2} \\ a_3 = \frac{2R_1R_2C}{R_1+R_2} \end{cases}$

With the specified resistors and capacitors, we have

$\begin{cases} a_1 = -1.61 \times 10^{-6} \\ a_2 = 2.41 \times 10^{-12} \\ a_3 = 3.21 \times 10^{-7} \end{cases}$

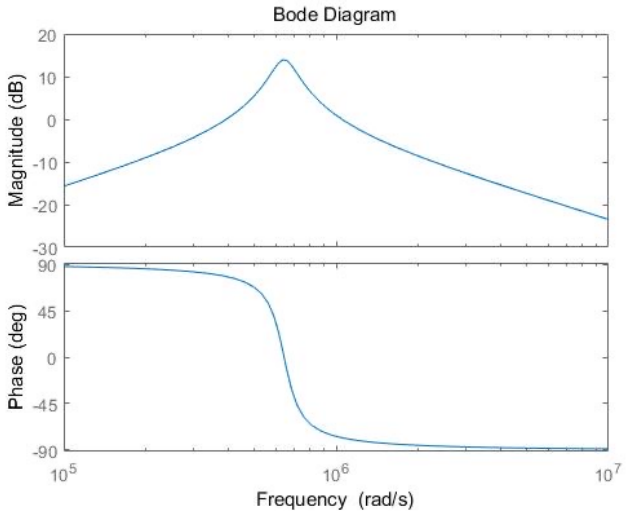
(b). $H(j\omega) = \dfrac{a_1 s}{a_2 s^2 + a_3 s + a_4} = \dfrac{\frac{a_1}{a_2} s}{s^2 + \frac{a_3}{a_2} s + \frac{a_4}{a_2}}$

$\omega_0 = \sqrt{\dfrac{a_4}{a_2}} = \sqrt{\dfrac{R_1 + R_2}{R_1 R_2 R_3 C^2}} = 6.44 \times 10^5$ rad/s $\Rightarrow$ 102.5 kHz

$\beta = \dfrac{a_3}{a_2} = \dfrac{2}{R_3 C} = 1.33 \times 10^5$ rad/s $\Rightarrow$ 21.2 kHz

$H_0 = \dfrac{a_1}{a_3} = -\dfrac{R_3}{2R_1} = 5 = 13.98$ dB

(C).



From plot, we have

$a_3 = 3.21 \times 10^7$

$\omega_0 = 6.37 \times 10^5$ rad/s

$\Rightarrow$ 101.4 kHz

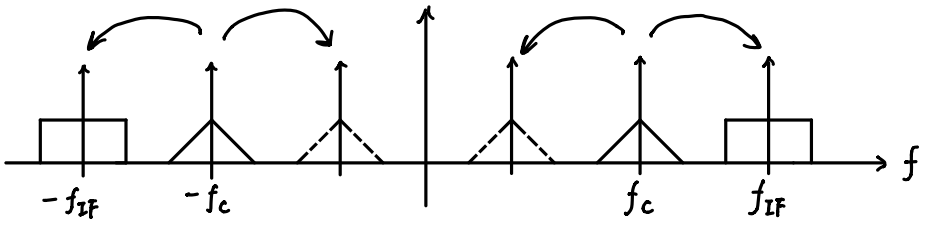
$H_0 = 13.9$ dB

Therefore, the approximation is quite good.

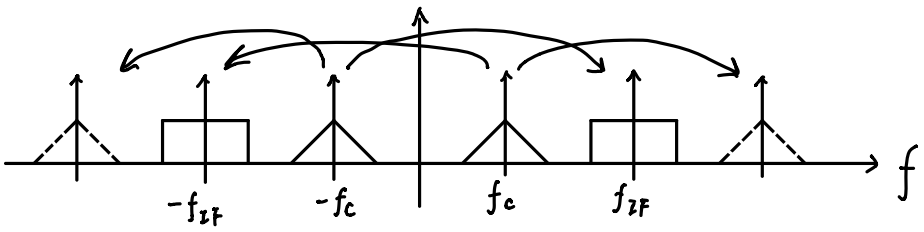
3.

f_c (kHz)	f_{LO1} (kHz)	f_{LO2} (kHz)	f_{image1} (kHz)	f_{image2} (kHz)
1600	1500	1700	1400	1800
530	430	630	330	730

4.



$f_{LO} = f_{IF} - f_c$



$f_{LO} = f_{IF} + f_c$