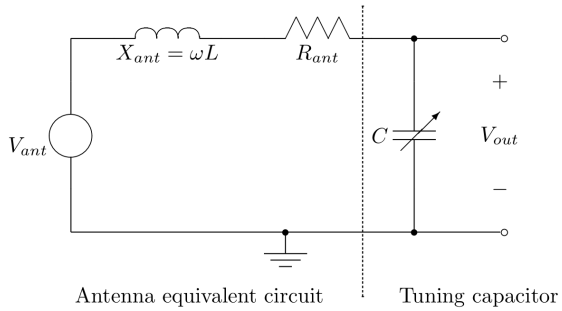
3.1



Antenna equivalent circuit Tuning capacitor

(a) $H(j\omega) = \frac{\frac{1}{Cj\omega}}{\frac{1}{Cj\omega} + Lj\omega + R} = \frac{1/C}{Ls^2 + Rs + \frac{1}{C}} = \frac{1}{LCs^2 + RCs + 1}$

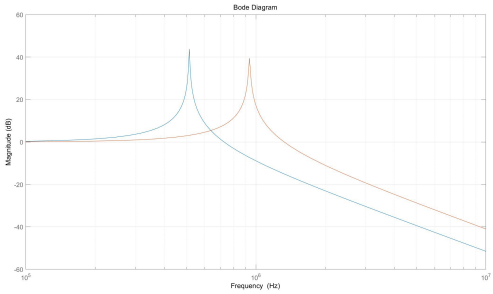
(b) $\Rightarrow f_{res} = \frac{1}{2\pi}\frac{1}{\sqrt{LC}}$, $BW_{3dB} = \frac{1}{2\pi}\frac{R}{L}$, $Q = 2\pi \cdot f_{res}\frac{L}{R}$

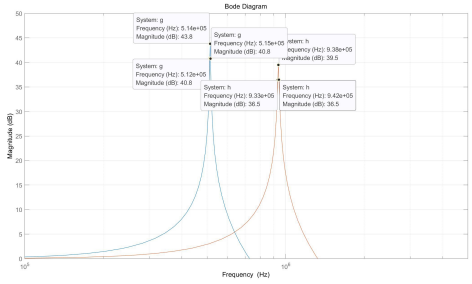
	Peak freq. (kHz)	3dB BW (kHz)	Quality Factor
C = 100 pF	513.7	3.3	154.9
C = 30 pF	937.8	14.9	62.9

Table 3.1: Values from Plot or Equations

513.7 3.3 155.7

937.8 14. 62.



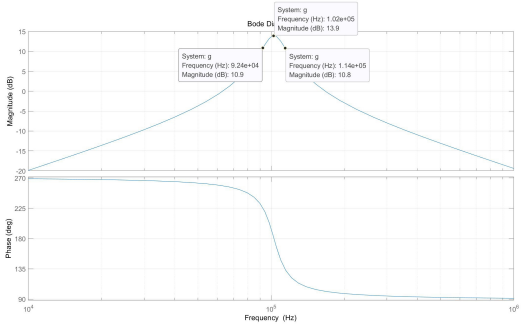


3.2 (a) $\begin{cases} \frac{Ux}{R_2} + \frac{Ux - V_i}{R_1} + \frac{Ux - 0}{1/Cwj} + \frac{Vx - V_o}{1/Cwj} = 0 \\ \frac{Ux - 0}{1/Cwj} + \frac{V_o}{R_3} = 0 \end{cases} \Rightarrow H(jw) = \frac{V_o}{V_i} = \frac{-R_2R_3C/(R_1+R_2)\cdot s}{1 + \frac{2R_1R_2C}{R_1+R_2}s + \frac{R_1R_2R_3C^2}{R_1+R_2}s^2} \Rightarrow \begin{cases} a_1 = -1.67\times10^{-6} \\ a_2 = 2.49\times10^{-12} \\ a_3 = 3.32\times10^{-7} \end{cases}$ $H(jw) = \frac{a_1 s}{a_2 s^2 + a_3 s + 1}$

(b) $H(jw) = \frac{a_1 s}{a_2 s^2 + a_3 s + 1} = \frac{a_1}{a_2} \cdot \frac{a_3/a_2 \cdot s}{s^2 + a_3/a_2 s + 1/a_2} \Rightarrow H(0) = \frac{a_1}{a_2}$ $B = \frac{a_3}{a_2}$ $w_0^2 = \frac{1}{a_2}$

$\Rightarrow f_{res} = \frac{w_0}{2\pi} = 1.02\times10^5\,Hz$ $|H_0| = \frac{R_3}{2R_1} = 5 \approx 14\,dB$ $BW = \frac{B}{2\pi} = 2.12\times10^4\,Hz$

(c)



$a_3 = 3.32\times10^{-7}$

$f_{res} = 1.03\times10^5\,Hz$

$H_0 \approx 14\,dB$

$BW = 2.2\times10^4\,Hz$

closed to b

3.3 (a)

① $f_O = 1500\,kHz$ $f_I = 1470\,kHz$ ② $f_O = 1700\,kHz$ $f_I = 1830\,kHz$

(b)

① $f_O = 430\,kHz$ $f_I = 390\,kHz$ ② $f_O = 630\,kHz$ $f_I = 730\,kHz$

f_c (kHz)	f_{LO1} (kHz)	f_{LO2} (kHz)	f_{I1} (kHz)	f_{I2} (kHz)
1600	1500	1700	1400	1800
630	430	630	230	730

3.4 (1) $f_{LO} = f_{IF} - f_C$ (2) $f_{LO} = f_{IF} + f_C$